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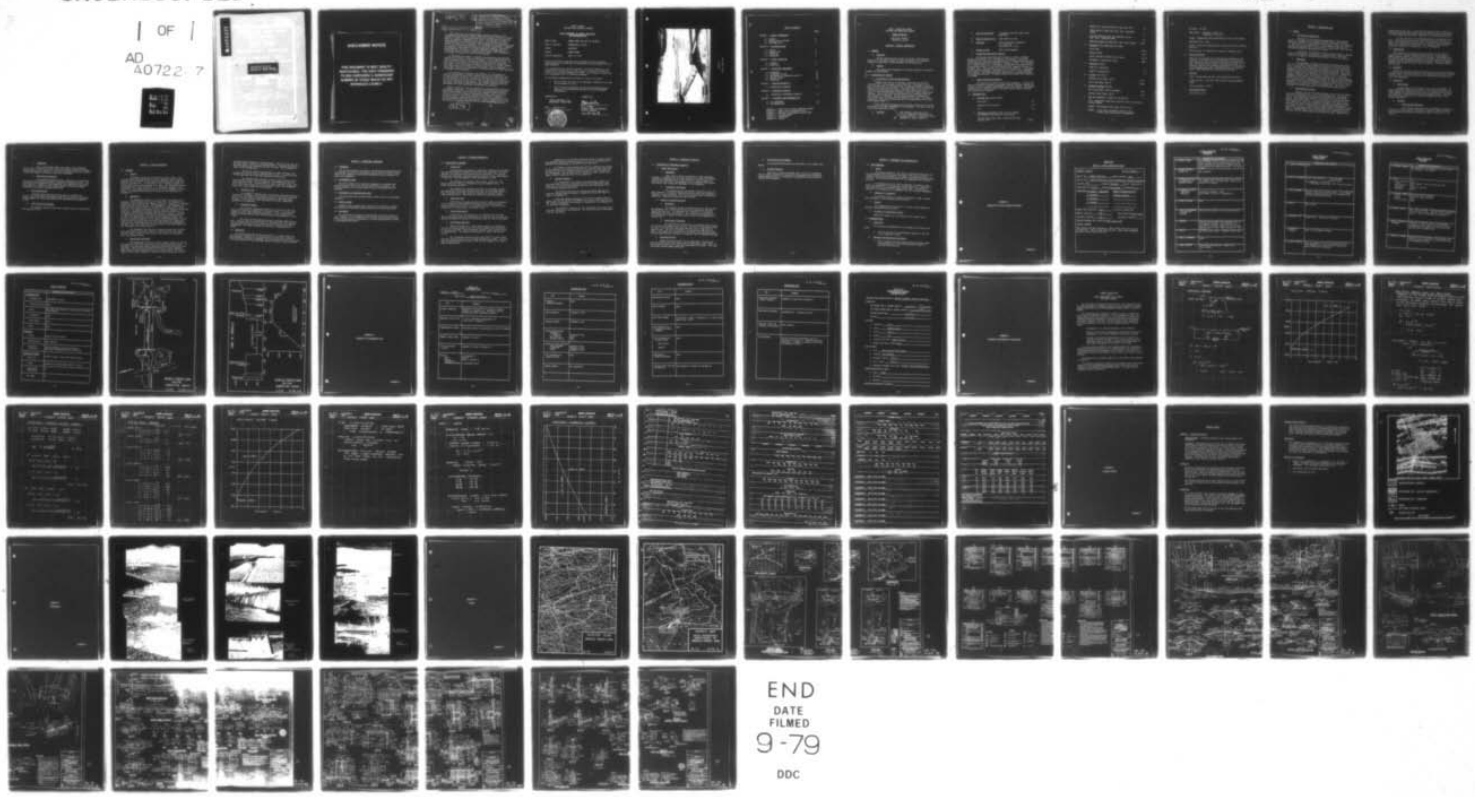

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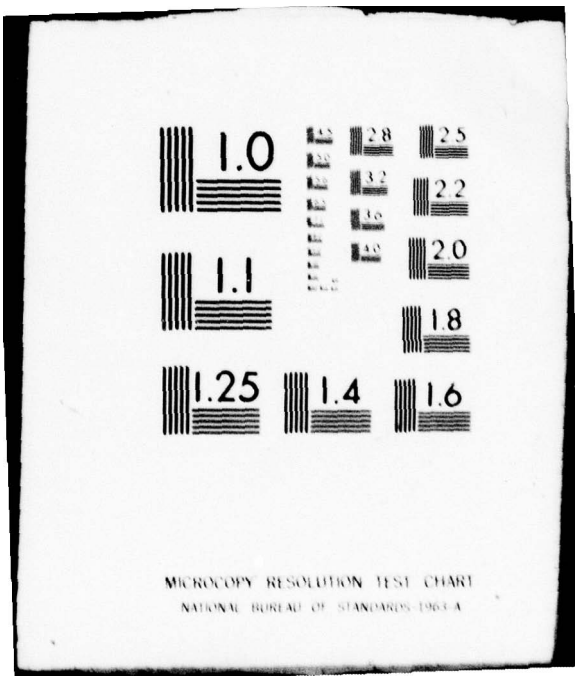
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(11) May 79

(6) National Dam Inspection Program. Middle Creek Dam (NDI Number PA-00731, DER Number 36-259), Susquehanna River Basin, Lancaster County, Pennsylvania. Phase I Inspection Report.

(15) DACW31-79-C-0012

PREFACE

This report has been prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evoluntionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

BRIEF ASSESSMENT OF GENERAL CONDITIONS AND RECOMMENDATIONS

Name of Dam:	MIDDLE CREEK DAM, NDI NO. PA-00731
State & State No:	PENNSYLVANIA, 36-259
County:	LANCASTER
Stream:	MIDDLE CREEK
Date of Inspection:	April 17, 1979

Based on the visual inspection, past performance and the available engineering data, the dam and its appurtenant structures appear to be in good condition.

In accordance with the Corps of Engineers' evaluation guidelines, the combination of storage and spillway capacity is capable of passing 60 percent of the Probable Maximum Flood (PMF). The spillway is considered to be inadequate, but not seriously inadequate.

The following recommendations are made for action by the owner:

1. That the small low spot in the embankment, adjacent to the end of the walkway be filled.

2. That a formal surveillance and downstream warning system be developed to be used during periods of high or prolonged precipitation.

SUBMITTED BY:

BERGER ASSOCIATES, INC.
HARRISBURG, PENNSYLVANIA

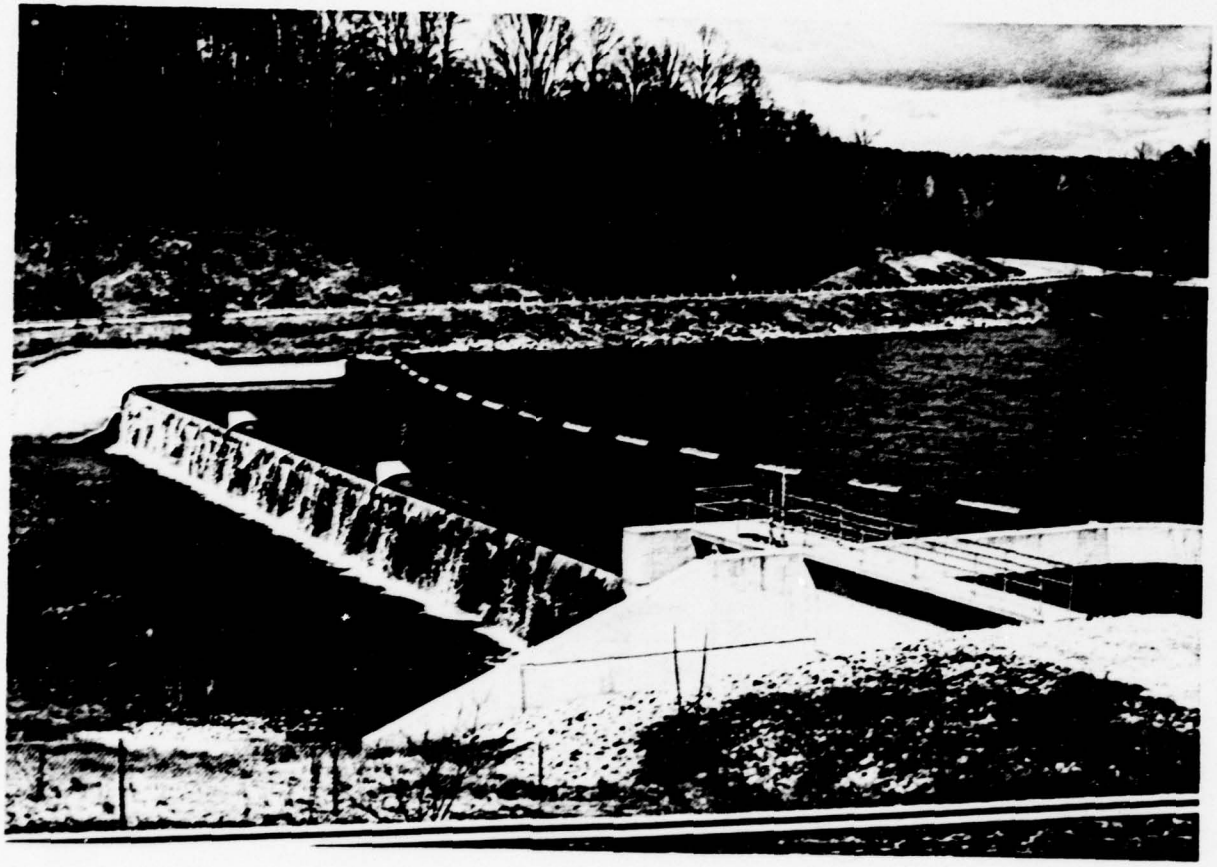
DATE: May 29, 1979

COMMONWEALTH OF PENNSYLVANIA
REGISTERED
PROFESSIONAL
HENDRIK JONGSMA
ENGINEER
No. 5557E

APPROVED BY:

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer

DATE 27 Jun 79



OVERVIEW

MIDDLE CREEK DAM

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

MIDDLE CREEK DAM

NDI-ID NO. PA-00731
DER-ID NO. 36-259

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

A. Authority

The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspections of dams throughout the United States.

B. Purpose

The purpose is to determine if the dam constitutes a hazard to human life and property.

ABSTRACT

1.2 DESCRIPTION OF PROJECT

A. Description of Dam and Appurtenances

Middle Creek Dam is an earthfill, sheetpile and concrete structure with a total length of about 500 feet. The height of the dam is 18 feet above the streambed with the maximum height of embankment being 10 feet above natural ground. The center half of the structure is a 250 foot long spillway and control structure constructed of two parallel lines of sheetpiling retaining a zoned fill and is capped with concrete. The 15 feet wide control structure is accessible from the left abutment by a walkway. The structure contains a minimum flow sluice gate and a 18-inch by 36-inch drawdown sluice gate. The downstream area, below the vertical drop weir, is protected with an 18-inch thick concrete slab.

The spillway is connected with concrete cutoff walls on top of sheetpiles to the earth embankment at the abutments. The top of the dam is 4.0 feet above weir crest.

B. Location:

Clay Township, Lancaster County
U.S.G.S. Quadrangle, Womelsdorf, PA
Latitude 40°-15.9', Longitude 76°-14.3'
(Appendix F, Plates I and II)

ABSTRACT

C. Size Classification: Intermediate (18 feet high, 3,030 acre-feet)

D. Hazard Classification: High (Section 3.1.E)

E. Ownership: Pennsylvania Game Commission
P. O. Box 1567
Harrisburg, PA 17120

F. Purpose of Dam: Water Fowl Management

G. Design and Construction History:

The dam and facilities were designed by Gannett, Fleming, Corddry and Carpenter, Inc., Harrisburg, Pennsylvania. The permit application for construction was approved by the Pennsylvania Department of Environmental Resources (PennDER) on January 12, 1971. The contractor was J. Robert Bazley, Inc., Pottsville, Pennsylvania, who started actual construction on April 1, 1971, and substantially completed the work in December, 1971. The grouting of the rock in the abutments was performed by Coal Drilling Company, a subsidiary of B. H. Mott & Sons, Huntington, West Virginia. The construction was supervised by a resident engineer of the design consultant. Bi-weekly construction reports were submitted to PennDER.

H. Normal Operating Procedures

The reservoir is used for water fowl management. A large area around the reservoir provides undisturbed resting, loafing, feeding and nesting areas for resident and migratory water fowl species. The shallow reservoir forms a marshy habitat. The pool level is kept at spillway weir elevation year around.

1.3 PERTINENT DATA

A. Drainage Area (square miles)

From files -	7.4
Computed for this report -	7.8
Use	7.8

B. Discharge at Dam Site (cubic feet per second)
See Appendix C for hydraulic calculations

Maximum known flood, since construction of dam, June 22, 1972	1,615

Outlet works low pool outlet at pool Elev. 535	36
Outlet works at pool level Elev. 542.5 (spillway crest)	73
Low pool spillway (stop logs removed) at pool Elev. 542.5 (spillway crest)	89
Spillway capacity at pool Elev. 546.5 (top of dam)	7,125

C. Elevation (feet above mean sea level)

Top of dam	546.5
Spillway crest	542.5
Invert (18-inch x 36-inch sluice gate)	531.25
Streambed at centerline of dam	528.0

D. Reservoir (miles)

Length of normal pool	1.2
Length of maximum pool	1.4

E. Storage (acre-feet)

Spillway crest (Elev. 542.5)	1,300
Top of dam (Elev. 546.5)	3,030

F. Reservoir Surface (acres)

Top of dam (Elev. 546.5) from HEC-1	538
Spillway crest (Elev. 542.5)	365

G. Dam (See Appendix F, Plates III through IX)

Type: Homogeneous impervious earthfill with a rock facing on both slopes.

Length: Two abutments each about 100 feet long.

Height: 18 feet above streambed (sheetpile wall).
10 feet above natural ground (embankment).

Top Width: 20 feet.

Side Slopes: Upstream - 2.8H to 1V.
Downstream - 2.5H to 1V.

Zoning: Homogeneous with sheetpiling over part of the length.

Impervious Core: None.

Cutoff: Trench on centerline dam to solid rock with a concrete groutcap.

Grout Curtain: On centerline of trench at abutments only.

H. Outlet Facilities

There are two openings in the concrete wall adjacent to the spillway, on the left side, one controlled by a 6-inch by 6-inch sluice gate and the other by a 18-inch by 36-inch sluice gate. Both gates have an invert elevation of 531.25. In addition, there are two openings 4-feet wide by 5.5-feet high for discharging water over a broadcrested weir at elevation 540.0. These openings are controlled by stop logs.

I. Spillway

Type: Uncontrolled ogee weir with sloping upstream face.

Length of weir: 232.5 feet with vertical concrete abutment walls.

Crest elevation: 542.50.

J. Regulating Outlets

See Section 1.3.H.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

A. Hydrology and Hydraulics

The files of the Pennsylvania Department of Environmental Resources (PennDER) did not contain hydraulic design data for this structure, except the area-capacity curves shown on Plate III, Appendix F. The report on the application for construction stated that the spillway was designed for a Q of 6,500 cfs, slightly more than what was required according to Pennsylvania's C-curve.

A hydrologic and hydraulic study was made by Gannett, Fleming, Corddry and Carpenter, the designer, including rating curves and a review of the depth of tailwater (See Section 5.1.A of this report).

B. Embankment

The embankment of Middle River Creek Dam extends over about 100 feet of length at each abutment, where the dam ties into the sidehills. Highways were relocated to the sidehill. A cutoff trench was excavated to top of rock and after installing a grout cap, (see Plate V, Appendix F) grout holes were drilled and pressure grouted. This grout curtain extends over the length of the cutoff trench only. Beyond this trench, a sheetpile wall was driven to the top of rock. Where the embankment slopes down to the spillway training wall, the sheetpile was capped with a concrete wall (I-wall section, see Plate V and IX, Appendix F). The slopes of the embankment are 2.8H to 1V upstream and 2.5H to 1V downstream. The impervious material is protected with a layer of stone, one foot thick, placed on a 9-inch thick gravel bed. The top of the embankment is 20-feet wide and has an 8-inch thick gravel surface.

C. Appurtenant Structures

Besides a full set of design drawings in the files of PennDER, the owner and designer have a set of as-built drawings. The design files of the appurtenant structures were reviewed in the consultant's office. These structures consist of a 250-feet long cellular structure between the training walls. For typical sections, see Plate VII and VIII, Appendix F. The actual spillway is formed by two parallel sheetpile walls at 18-foot centers driven to rock and tied together with 2-inch round tie rods. A zoned fill was placed between the sheetpile walls and the fill was capped with an 18-inch thick slab over which the water flows. A modified ogee section was installed at the downstream end of the slab, with the crest being 1.5 feet above the slab. About 23 feet

downstream from the weir, a third parallel sheetpile wall was driven to rock and the surface area between this wall and the weir was paved with a 1.5 foot thick concrete slab. This slab is 12 feet below weir crest.

At the left end of the overflow section is the control structure. This structure consists of a low flow sluice gate (6-inch x 6-inch), a drawdown sluice gate (18-inches x 36-inches) and two openings which can be adjusted with stop logs. The operator stands are on a platform, accessible by a walkway on top of the wingwall.

2.2 CONSTRUCTION

The construction of these facilities occurred in 1971 under the supervision of a resident engineer employed by the design engineer. Regular progress reports were submitted to PennDER. These reports and the as-built drawings indicate that the facilities were constructed as designed and that no major modifications occurred. Records of grouting indicate that the grout take was small (average of .24 bag per linear foot of hole).

2.3 OPERATION

Records of operation, which would indicate exact pool levels during maximum inflows, are not maintained. The drawdown sluice gate is operated at least twice a year and the pool level is maintained as required for water fowl management.

2.4 EVALUATION

A. Availability

Design drawings were available in the files of PennDER. The design consultant (GFCC) made available to the inspection team the as-built drawings (no changes) and the design calculations for the structural stability of the overflow section and sheetpile walls. The owner has also copies available of the as-built drawings and some of the design calculations.

B. Adequacy

1. Hydrology and Hydraulics

The available engineering data was adequate to review the designer's criteria used for the hydraulic design of these facilities. For a comparative discussion, reference is made to Section 5 of this report.

2. Embankment

Due to the limited height and length of the embankment and the type of construction used, the actual design criteria and design calculations were not extensive. Review of the construction data indicate a more than adequate section for this short embankment.

3. Appurtenant Structures

The available engineering data, consisting of calculations and construction drawings indicate an adequately designed facility. The structures were designed for full reservoir, for construction and normal pool condition. Details on the drawing indicate a facility designed according to acceptable engineering practice.

C. Operating Records

Although formal operating records were not available for review, the visual inspection indicates that the structure has withstood, without damage, the flows experienced since construction was completed in 1971.

D. Post Construction Changes

No changes or additions have been reported since the construction was completed in 1971.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

A. General

The general appearance of Middle Creek Dam is good. This recently (1971) constructed facility is in apparently good condition, although the area of the toe and sidehills downstream of the dam abutments are wet and soft. A field office, with a visitor's center, is located about half a mile upstream of the dam. The inspection team was accompanied for a short time by Mr. C. L. Strouphar, Manager of the facilities. The visual inspection check list is in Appendix A of this report. Photographs taken during the inspection are reproduced in Appendix E.

B. Embankment

The embankment consists of only two small sections at the abutments, where the dam abuts into the sidehills. The sidehills were excavated on both sides for new highways, which are located at an elevation higher than the top of the dam. The embankments at the abutments are protected with riprap and the top of the fill is covered with a layer of gravel. The profile and typical section surveyed during the inspection (Plate A-II, Appendix A), indicate that the existing condition is in accordance with the design drawings (Appendix F). Plate A-I, Appendix A, indicates large areas of wet and soft conditions beyond the toe of the dam. The appearance of the water on the sidehills indicate that most of this water originates in the higher surrounding ground. The wet condition can be noticed above and just below normal pool elevations. There were no indications that any water came through the embankment of the dam. There is a small low spot on the crest of the dam adjacent to the footbridge, which needs some fill.

The embankment ties into the spillway sections with concrete walls which were in excellent condition. The wall on the left side carries a small walkway, to the control works, which is incorporated with the spillway section.

C. Appurtenant Structures

The appurtenant structures form the largest section of the dam and consist of a 250 foot long concrete and steel sheetpile section, including a 15-foot wide section containing regulating sluice gates and stop logs. The 235 foot long overflow section is in good condition. Water drops 12.0 feet from the weir onto a concrete slab. The flow of water, at the time of inspection, prevented close observation, but all

concrete surfaces appeared in good condition. The top of the weir has two small piers, acting as ice breaking devices. Although the flow of water was small, some tailwater was over the slab, thus, breaking the force of the falling water.

On the left side of the spillway is a small structure containing an 18-inch by 36-inch drawdown sluice gate, a 6-inch by 6-inch low flow gate and two 4-feet wide openings with stop logs.

The drawdown sluice gate was operated satisfactorily during the inspection and was in good condition. The minimum flow gate is always partially open. The stop logs are used to maintain a pool level of 2.5 feet below normal pool if so desired for water fowl management. There are no outlet pipes in this structure.

D. Reservoir Area

The immediate reservoir area is partially wooded and partially cultivated. The banks of the reservoir are stable and little siltation occurs. For the purpose of waterfowl management, many small ponds (a total of 70 acres) have been constructed in the area immediately upstream of the reservoir.

E. Downstream Channel

The immediate downstream channel has a relatively wide flood plain with normal flow contained in a natural stream. A new two-span bridge is located about 600 feet downstream. It was reported that during the Agnes storm in 1972, the water came to the underside of this bridge.

The valley narrows beyond the bridge and widens again within a mile. Several homes are located close to the stream and it is expected that the hazard to loss of life would increase if the dam fails due to overtopping. The hazard category for this dam is considered to be "High".

3.2 EVALUATION

The dam and appurtenant facilities appear to be in good condition. The structural integrity of the dam appears to be good and no signs of deterioration, settlement or movement were discovered during the inspection. A low area adjacent to the footbridge should be filled to crest elevation.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The dam and reservoir are owned by the Pennsylvania Game Commission, who maintain a field office and visitor center close to the dam. Water level in the reservoir is controlled through the year as required for water fowl management.

4.2 MAINTENANCE OF DAM

The short length of the earthfill embankments are covered with riprap and gravel and do not need any maintenance at present. The spillway appears to be in good condition and no maintenance work is required.

4.3 MAINTENANCE OF OPERATING FACILITIES

The sluice gates are operated several times a year and are greased regularly.

4.4 WARNING SYSTEM

Although field personnel drive daily by the facilities, a formal surveillance and downstream warning system has not been established.

4.5 EVALUATION

The operational procedures for maintenance of the facilities are good. However, it is recommended that a formal surveillance and downstream warning system be established to be used during periods of heavy or prolonged precipitation.

SECTION 5 - HYDROLOGY/HYDRAULICS

5.1 EVALUATION OF FEATURES

A. Design Data

The hydrologic and hydraulic information available from PennDER and from the designer of Middle Creek Dam was quite extensive. An area-capacity curve and spillway rating curve were available. The spillway rating curve indicated a maximum discharge capacity, without overtopping, of 7,844 cfs. This was based on a weir coefficient of 4.09.

The designer had computed a PMF of about 14,400 cfs. The design flood was 6,500 cfs, determined from the PennDER C-curve. No flood routing was available.

The designer had evaluated the effect of the bridge located just downstream of the dam, and determined that the resulting backwater from the design flood would cause the tailwater at the dam to be at about elevation 542.9. This would not affect the discharge capacity.

B. Experience Data

There were no records available for past floods, but personnel of the Pennsylvania Game Commission reported that the maximum known flood occurred in June, 1972. At that time the water level rose to an elevation of 18 inches above the spillway crest.

C. Visual Observations

On the date of the inspection, no conditions were observed that would indicate that the appurtenant structures of the dam could not operate satisfactorily during a flood event, until the dam is overtopped.

D. Overtopping Potential

Middle Creek Dam has a total storage capacity of 3,030 acre-feet and an overall height of 18 feet above streambed, both referenced to the top of the dam. These dimensions indicate a size classification of "Intermediate". The hazard classification is "High" (see Section 3.1.E).

The recommended Spillway Design Flood (SDF) for a dam having the above classifications is the Probable Maximum Flood (PMF). For this dam, the PMF peak inflow is about 14,200 cfs (see Appendix C for HEC-1 inflow computations).

Comparison of the estimated PMF peak inflow of 14,200 cfs with the estimated spillway discharge capacity of 7,125 cfs indicates that a potential for overtopping of the Middle Creek Dam exists.

An estimate of the storage effect of the reservoir and routing of the computed inflow hydrograph through the reservoir shows that this dam does not have the necessary storage available to pass the PMF without overtopping. The spillway-reservoir system can pass a flood event equal to 60% of a PMF (see Sheet 9 of Appendix C).

E. Spillway Adequacy

The intermediate size category and high hazard category, in accordance with the Corps of Engineers criteria and guidelines, indicates that the Spillway Design Flood (SDF) for this dam should be the full Probable Maximum Flood (PMF).

Calculations show that the spillway discharge capacity and reservoir storage capacity combine to handle 60% of the PMF (Refer to Sheet 9 of Appendix C).

Since the spillway discharge and reservoir storage capacity cannot pass the PMF without overtopping, but can pass more than one-half PMF without overtopping, the spillway is considered to be inadequate but not seriously inadequate.

The hydrologic analysis for this investigation was based upon existing conditions of the watershed. The effects of future development were not considered.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

A. Visual Observation

1. Embankment

There were no visual indications of undue embankment stresses or sloughage and the slopes appear to be stable and adequate. Although the downstream area is wet and soft at several places, it appears that this stems from drainage from the sidehills and roadway cuts rather than through the embankment or its foundation.

2. Appurtenant Structures

The spillway and the operational facilities are all in good condition. The visual observation did not notice any problems in stability or wall movements. All concrete surfaces were in excellent condition. Downstream erosion has not occurred.

B. Design or Construction Data

1. Embankment

The available design and construction data indicate that the embankment was designed and constructed in accordance with good engineering practice. The abutments were excavated to rock and the underlying rock strata was grouted. The transition from embankment to the spillway has a sheetpile wall driven to rock and is capped with a concrete wall.

2. Appurtenant Structures

The spillway is constructed on two sheetpile walls driven to rock and tied together with tie rods. The 18 foot wide space between the piles is filled with zoned select material and is topped with a concrete slab. The fill is drained at the downstream side with weep-holes. The design and construction data indicate good engineering and a well detailed structure, adequate in stability for all expected loadings.

C. Operating Records

Formal operating records are not maintained. Maximum flow over the spillway occurred during tropical storm Agnes (June, 1972), at which time the depth at the weir was approximately 18 inches. This flow was passed without damage downstream.

D. Post Construction Changes

No reported modifications have been made to the original dam design.

E. Seismic Stability

This dam is located in Seismic Zone 1 and it is considered that the static stability is sufficient to withstand minor earthquake induced dynamic forces. No studies or calculations have been made to confirm this assumption.

SECTION 7 - ASSESSMENT AND RECOMMENDATIONS

7.1 DAM ASSESSMENT

A. Safety

The visual inspection, the review of available design data and the operational history indicates that Middle Creek Dam is in good condition and has been designed in accordance with acceptable engineering practice. The maintenance procedures for the embankment and facilities are good.

In accordance with the Corps of Engineers' evaluation guidelines, the combination of storage and spillway capacity is sufficient to pass 60 percent of the Probable Maximum Flood (PMF). The spillway, therefore, is considered to be inadequate, but not seriously inadequate.

B. Adequacy of Information

The available data is considered sufficient to make a reasonable assessment of the embankment and facilities.

C. Urgency

The recommendations presented as a result of this inspection should be implemented without delay.

D. Necessity for Additional Studies

Additional studies are not required at the present time.

7.2 RECOMMENDATIONS

A. Facilities

The following recommendations are presented for action by the owner:

1. That the low spot in the embankment adjacent to the end of the walkway be filled.

B. Operation and Maintenance Procedures

1. That a formal surveillance and downstream warning system be established to be used during periods of high or prolonged precipitation.

APPENDIX A

CHECKLIST OF VISUAL INSPECTION REPORT

CHECK LIST

PHASE I - VISUAL INSPECTION REPORT

PA DER # 36-259 NDI NO. PA-00731

NAME OF DAM Middle Creek Dam HAZARD CATEGORY High

TYPE OF DAM Concrete Weir Cap on Steel Sheetpiling - Earthfill abutments

LOCATION Clay TOWNSHIP Lancaster COUNTY, PENNSYLVANIA

INSPECTION DATE 4/17/79 WEATHER Cloudy-Windy TEMPERATURE 40's

INSPECTORS: R. Houseal (Recorder) OWNER'S REPRESENTATIVE(s):

R. Shireman Strouphar, Manager

A. Bartlett

H. Jongsma

NORMAL POOL ELEVATION: 542.5 AT TIME OF INSPECTION:

BREAST ELEVATION: 546.5 POOL ELEVATION: 542.6 (wind)

SPILLWAY ELEVATION: 542.5 TAILWATER ELEVATION:

MAXIMUM RECORDED POOL ELEVATION: 1972 - Weir + 18"

GENERAL COMMENTS:

Dam presents very good appearance. Water flowing over weir at time of inspection. Dam is almost entirely weir. Short earth embankment sections on both ends of the weir.

NDI NO. PA-00 731

VISUAL INSPECTION
EMBANKMENT

	OBSERVATIONS AND REMARKS
A. SURFACE CRACKS	The embankment portions of this structure are two short sections; one on either side of the weir. These sections are covered with dumped rock on both upstream and downstream slopes. No surface cracks.
B. UNUSUAL MOVEMENT BEYOND TOE	None observed.
C. SLOUGHING OR EROSION OF EMBANKMENT OR ABUTMENT SLOPES	The upstream and downstream slopes are covered with dumped stone - 12-inch size. There is no erosion or sloughing.
D. ALIGNMENT OF CREST: HORIZONTAL: VERTICAL:	Horizontal alignment - good. Good (Refer to Plate A-I, Appendix A).
E. RIPRAP FAILURES	None.
F. JUNCTION EMBANKMENT & ABUTMENT OR SPILLWAY	All junctions appear to be in good condition.
G. SEEPAGE	Seepage exists beyond left embankment slope on the natural hillside. This condition is attributed to natural springs in the hillside and not from the dam. Same condition on right hillside.
H. DRAINS	Low flow control gate. Drawdown control gate.
J. GAGES & RECORDER	None.
K. COVER (GROWTH)	Downstream and upstream - dumped rock. Top - gravel.

NDI NO. PA-00 731

VISUAL INSPECTION
OUTLET WORKS

	OBSERVATIONS AND REMARKS
A. INTAKE STRUCTURE	None.
B. OUTLET STRUCTURE	Outlet from Reservoir - 1. Low flow gate. 2. Blowoff gate. For Management of Reservoir - 1. Two bays of stop logs - 30" vertical distance.
C. OUTLET CHANNEL	Natural stream from spillway apron. All discharges through control gates and stop log openings enter into the spillway apron area.
D. GATES	See B above.
E. EMERGENCY GATE	Blowoff gate: 36-inches x 18-inches.
F. OPERATION & CONTROL	Water fowl management program.
G. BRIDGE (ACCESS)	Concrete walkway on top of retaining walls from left embankment onto gate and stop log control area at left side of spillway.

NDI NO. PA-00731

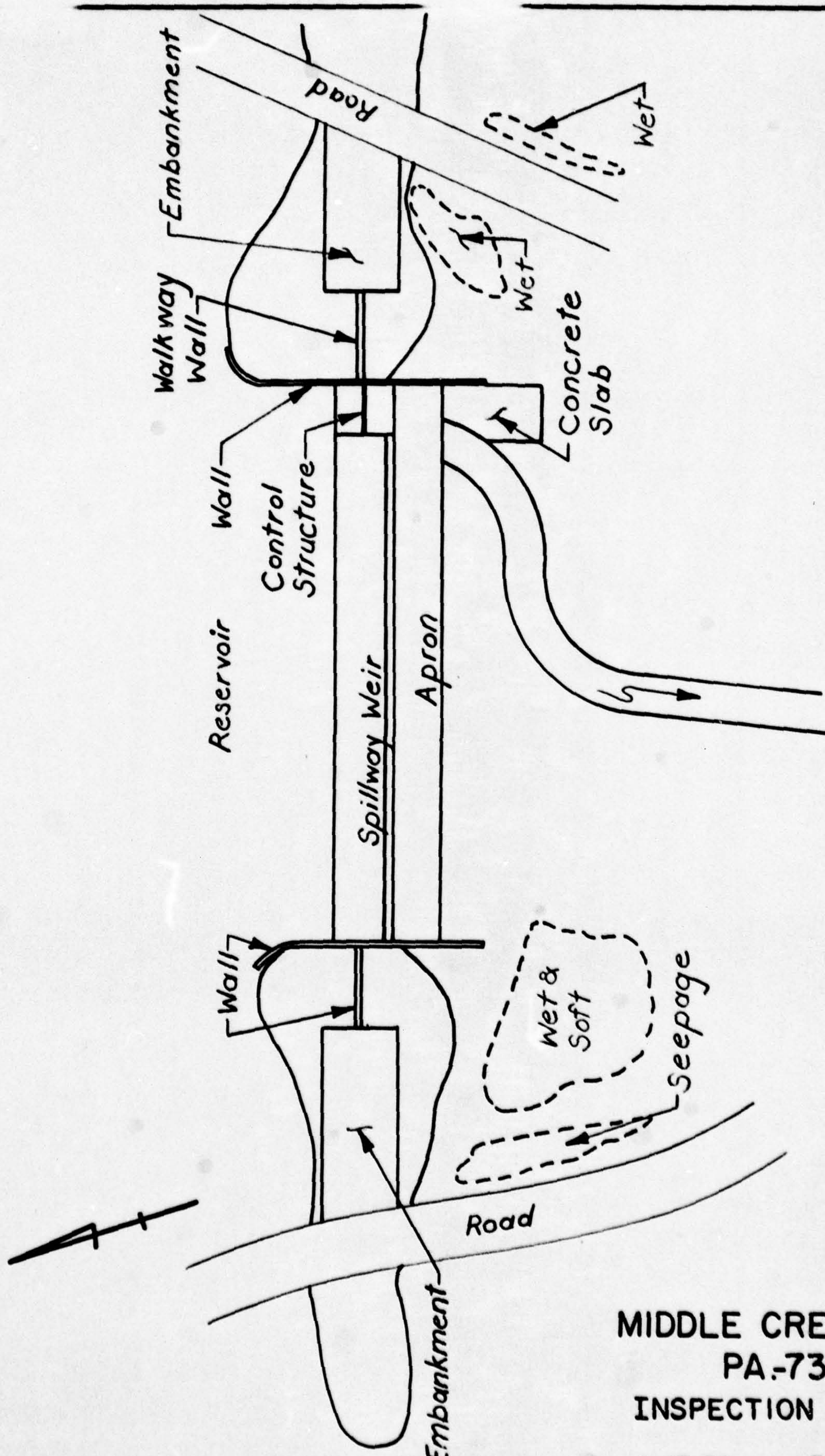
VISUAL INSPECTION
SPILLWAY

	OBSERVATIONS AND REMARKS
A. APPROACH CHANNEL	The approach to the spillway is directly from the reservoir - no channel.
B. WEIR: Crest Condition Cracks Deterioration Foundation Abutments	 Good. None visible - water flowing over weir. Nil. Could not observe. Good.
C. DISCHARGE CHANNEL: Lining Cracks Stilling Basin	Paved apron below spillway. Concrete - good condition. None. None.
D. BRIDGE & PIERS	None across spillway. Special concrete projections (2) on crest of weir. Reported as ice breaking devices. Refer to drawings for dimensions.
E. GATES & OPERATION EQUIPMENT	Gates are an integral part of the spillway, including low flow control and blowoff control. Blowoff gate was operated for this inspection. Low flow gate is always open.
F. CONTROL & HISTORY	Maximum flow over spillway - 18-Inch June, 1972. Control is in accordance with established water fowl management program.

NDI NO. PA-00 731

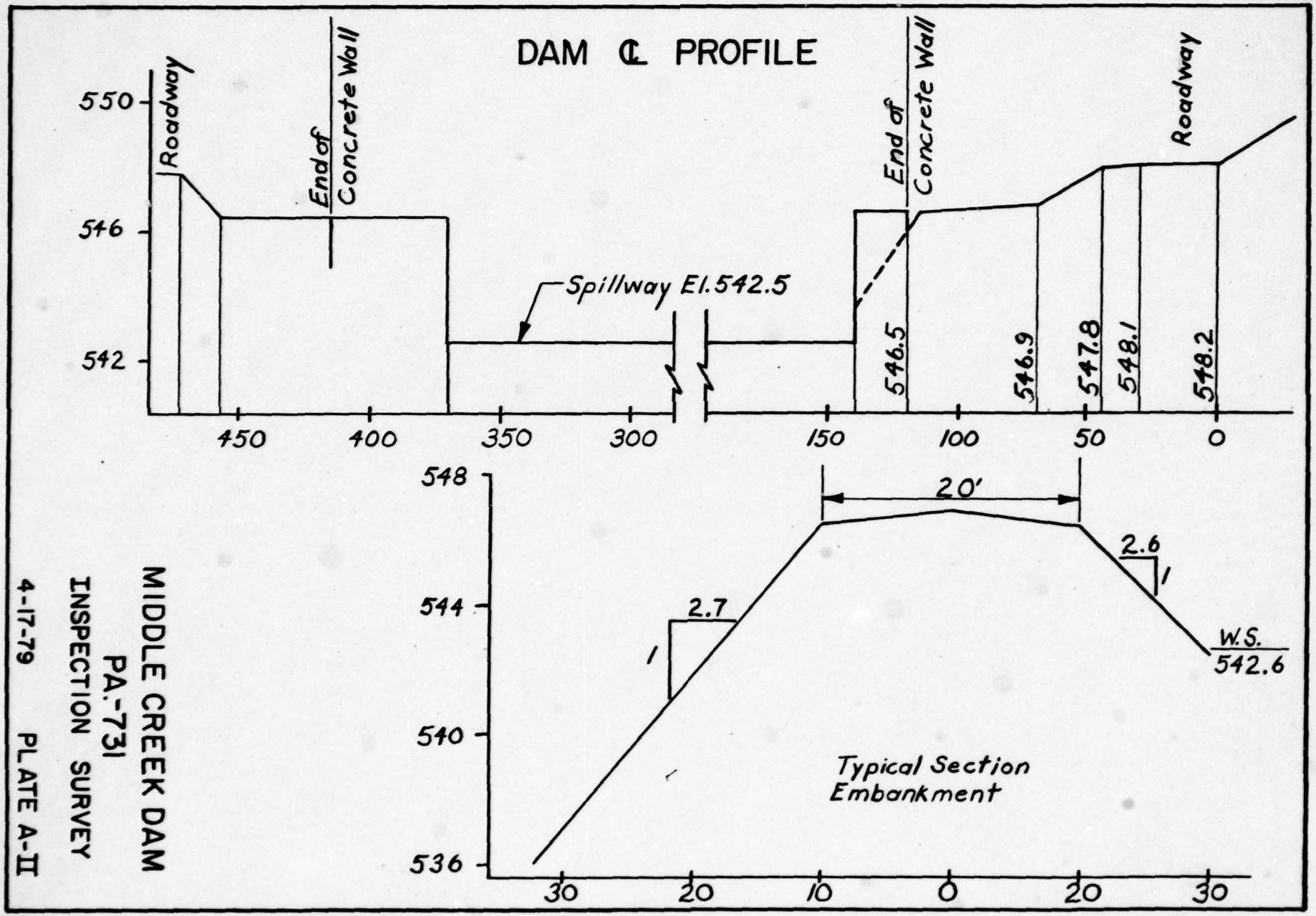
VISUAL INSPECTION

	OBSERVATIONS AND REMARKS
INSTRUMENTATION Monumentation	Benchmarks on walls.
Observation Wells	None.
Weirs	One used some time ago to verify low flow volume. Weir removed.
Piezometers	None.
Staff Gauge	None.
Other	None.
RESERVOIR Slopes	Slopes flat and stable.
Sedimentation	None reported.
Watershed Description	Partial woodland, partial cultivated. Many small breeding ponds for water fowl.
DOWNSTREAM CHANNEL Condition	Natural stream - first mile narrow valley.
Slopes	Wooded with several homes within 1.5 mile.
Approximate Population	40
No. Homes	15



MIDDLE CREEK DAM
PA.-731
INSPECTION SURVEY

4-17-79 PLATE A-I



MIDDLE CREEK DAM
PA.-731
INSPECTION SURVEY
4-17-79 PLATE A-II

APPENDIX B

CHECKLIST OF ENGINEERING DATA

CHECK LIST
ENGINEERING DATA

PA DER # 36-259 NDI NO. PA-00 731

NAME OF DAM Middle Creek Dam

ITEM	REMARKS
AS-BUILT DRAWINGS	Available at the offices of Gannett, Fleming, Corddry & Carpenter, Inc. (Designer) and the Pennsylvania Game Commission (Owner).
REGIONAL VICINITY MAP	U.S.G.S. Quadrangle, Womelsdorf, PA See Plate II, Appendix F
CONSTRUCTION HISTORY	Bi-weekly reports by consultants in file of PennDER.
GENERAL PLAN OF DAM	Appendix F, Plate V.
TYPICAL SECTIONS OF DAM	Appendix F, Plates V through IX.
OUTLETS: PLAN DETAILS CONSTRAINTS DISCHARGE RATINGS	See Appendix F. Plate V Plate V through IX. In designer's file.

NDI NO. PA-00 731

ENGINEERING DATA

ITEM	REMARKS
RAINFALL & RESERVOIR RECORDS	None.
DESIGN REPORTS	Designer's File.
GEOLOGY REPORTS	Designer's File.
DESIGN COMPUTATIONS: HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	 Designer's File. None. None.
MATERIALS INVESTIGATIONS: BORING RECORDS LABORATORY FIELD	 Designer's File. Designer's File. Designer's File.
POST CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	Not identified.

NDI NO. PA-00 731

ENGINEERING DATA

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	None.
HIGH POOL RECORDS	No official records. Estimated at 1.5 feet during Agnes (June, 1972).
POST CONSTRUCTION ENGINEERING STUDIES & REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM Description: Reports:	None.
MAINTENANCE & OPERATION RECORDS	None.
SPILLWAY PLAN, SECTIONS AND DETAILS	See Appendix F, Plates III through IX.

NDI NO. PA-00 731

ENGINEERING DATA

ITEM	REMARKS
OPERATING EQUIPMENT, PLANS & DETAILS	Appendix F, Plates III through IX.
CONSTRUCTION RECORDS	PennDER files. Bi-weekly reports.
PREVIOUS INSPECTION REPORTS & DEFICIENCIES	None reported.
MISCELLANEOUS	Not all construction drawings have been reproduced in Section F. Additional drawings available at PennDER, the owner's office and the designer's office.

NDI NO. PA-00 731

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Partial woodland, partial cultivated.

ELEVATION:

TOP NORMAL POOL & STORAGE CAPACITY: Elev. 542.5 1750 Acre-Feet

TOP FLOOD CONTROL POOL & STORAGE CAPACITY: Elev. 546.5 3300 Acre-Feet

MAXIMUM DESIGN POOL: Elev. 546.5

TOP DAM: Elev. 546.5

SPILLWAY:

a. Elevation 542.5

b. Type Modified Ogee

c. Width 232.5

d. Length 18

e. Location Spillover Center of Dam

f. Number and Type of Gates None.

OUTLET WORKS:

a. Type Stop logs and sluice gates.

b. Location Left abutment

c. Entrance inverts 531.25

d. Exit inverts 531.25

e. Emergency drawdown facilities 18-inch x 36-inch sluice gate

HYDROMETEOROLOGICAL GAGES:

a. Type None

b. Location

c. Records

MAXIMUM NON-DAMAGING DISCHARGE:

APPENDIX C

HYDROLOGY AND HYDRAULIC CALCULATIONS

SUMMARY DESCRIPTION
OF
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION

The hydrologic and hydraulic evaluation for this inspection report has employed computer techniques using the Corps of Engineers computer program identified as the Flood Hydrograph Package (HEC-1) Dam Safety Version.

The program has been designed to enable the user to perform two basic types of hydrologic analyses: (1) the evaluation of the overtopping potential of the dam, and (2) the capability to estimate the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. A brief summary of the computation procedures typically used in the dam overtopping analysis is shown below.

- Development of an inflow hydrograph to the reservoir.
- Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.
- Routing of the outflow hydrograph(s) of the reservoir to desired downstream locations. The results provide the peak discharge, time of the peak discharge and maximum stage of each routed hydrograph at the outlet of the reach.

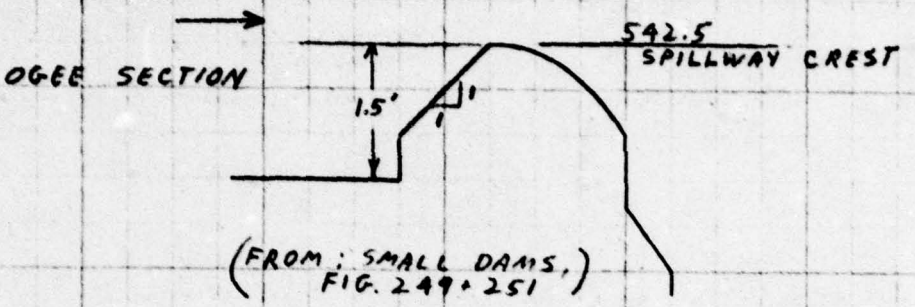
The output data provided by this program permits the comparison of downstream conditions just prior to a breach failure with that after a breach failure and the determination as to whether or not there is a significant increase in the hazard to loss of life as a result of such a failure.

The results of the studies conducted for this report are presented in Section 5.

For detailed information regarding this program refer to the Users Manual for the Flood Hydrograph Package (HEC-1) Dam Safety Version prepared by the Hydrologic Engineering Center, U. S. Army Corps of Engineers, Davis, California.

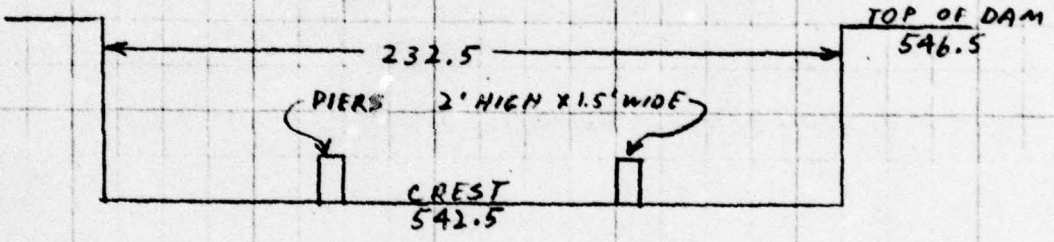
BY RLS DATE 9/26/79 | BERGER ASSOCIATES | SHEET NO. 1 OF
CHKD. BY DATE | PROJECT D8490
SUBJECT MIDDLE CREEK DAM

SPILLWAY RATING



(FROM: SMALL DAMS, FIG. 249-251)

C = 3.75 × 1.02 = 3.83



H = 546.5 − 542.5 = 4'

C = 3.83

L = 232.5

$Q = C L H^{3/2}$

$= 3.83 \times 232.5 \times (4)^{1.5}$

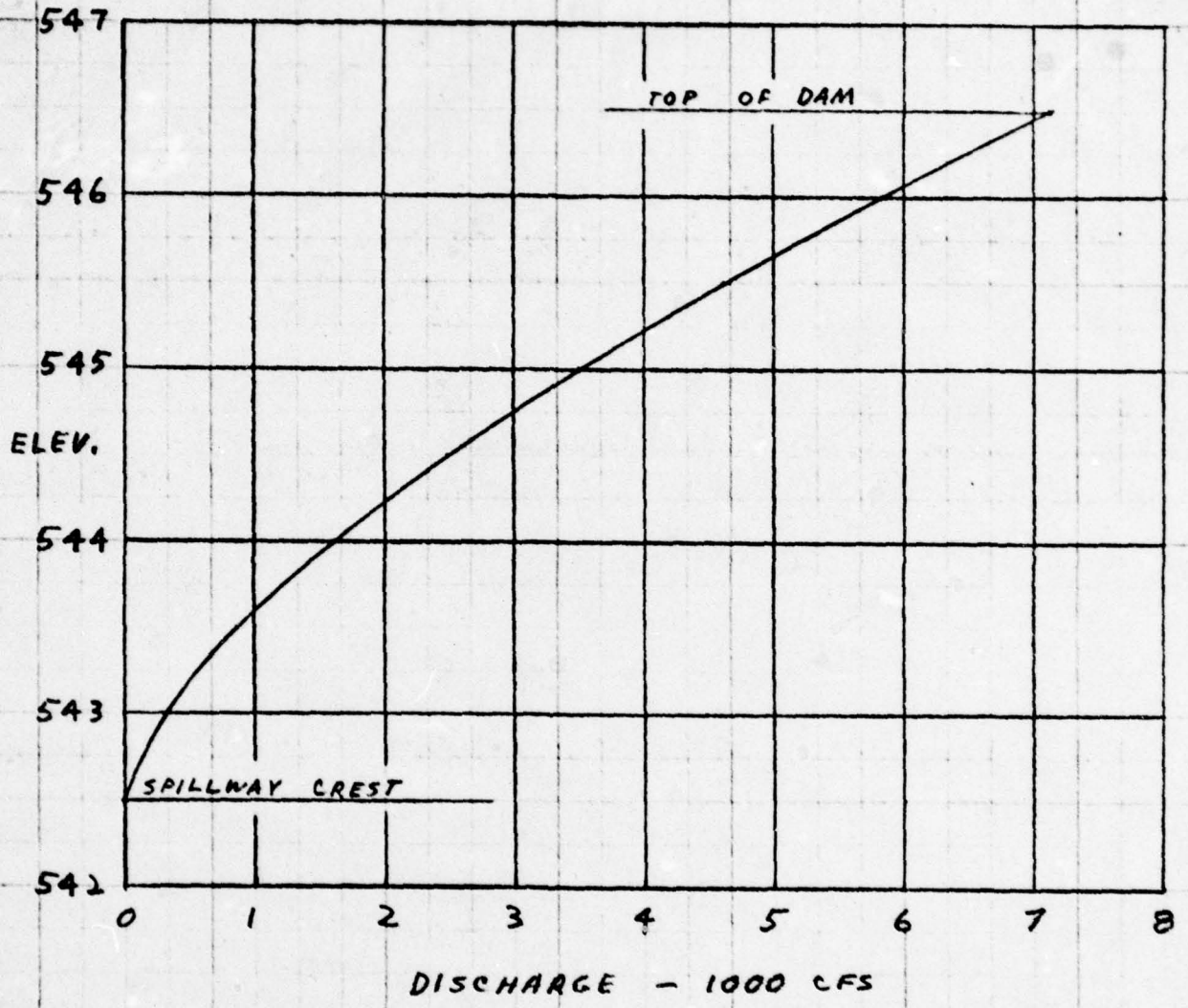
= 7124 SAY 7125 CFS

BY RLS DATE 4/30/79 | BERGER ASSOCIATES | SHEET NO. 2 OF

CHKD. BY DATE | PROJECT D8490

SUBJECT MIDDLE CREEK DAM

SPILLWAY RATING CURVE



MAXIMUM KNOWN FLOOD AT DAM SITE

PERSONNEL OF THE PENNA. GAME COMMISSION REPORTED THAT THE MAXIMUM KNOWN FLOOD AT MIDDLE CREEK DAM OCCURRED IN JUNE 1972 WHEN THE WATER LEVEL IN THE RESERVOIR REACHED AN ELEVATION 18" ABOVE THE SPILLWAY CREST

$C = 3.83$

$L = 232.5 - (2 \times 1.5) = 229.5$

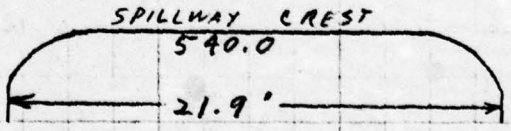
$H = 1.5'$

$Q = C L H^{3/2}$

$= 3.83 \times 229.5 \times (1.5)^{1.5}$

$= 1615$ CFS

DISCHARGE THROUGH LOW POOL SPILLWAY (STOP LOGS REMOVED)



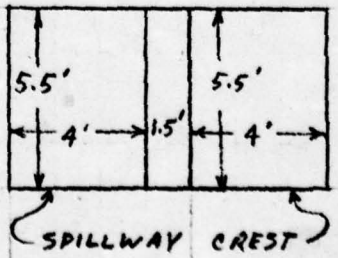
$C = 2.82$ (KING'S HDBK.)

$C = 2.82$

$H = 542.5 - 540$

$= 2.5'$ AT NORMAL POOL

$L = 2 \times 4 = 8'$



$Q = C L H^{3/2}$

$= 2.82 \times 8 \times (2.5)^{1.5} = 89$ CFS

BY RLS DATE 4/26/79 | BERGER ASSOCIATES | SHEET NO. 4 OF
CHKD. BY DATE | PROJECT D8490
SUBJECT MIDDLE CREEK DAM

DISCHARGE THROUGH OUTLET WORKS

18" x 36" SLUICE GATE INVERT = 531.25
6" x 6" SLUICE GATE INVERT = 531.25

CENTERLINE 18" x 36" GATE = 532.5
CENTERLINE 6" x 6" GATE = 531.5

$Q = C A \sqrt{2gH}$ $C = 0.6$

AT NORMAL POOL LEVEL 542.5

18" $H = 542.5 - 532.5 = 10'$

$Q = 0.6 \times (1.5 \times 3) \times \sqrt{2 \times 32.2 \times 10} = 69$

6" $H = 542.5 - 531.5 = 11'$

$Q = 0.6 \times (.5 \times .5) \times \sqrt{2 \times 32.2 \times 11} = 4$

$\Sigma Q = 73$ CFS

AT LOW POOL LEVEL 535

18" $H = 535 - 532.5 = 2.5'$

$Q = 0.6 \times (1.5 \times 3) \times \sqrt{2 \times 32.2 \times 2.5} = 34$

6" $H = 535 - 531.5 = 3.5$

$Q = 0.6 \times (.5 \times .5) \times \sqrt{2 \times 32.2 \times 3.5} = 2$

$\Sigma Q = 36$ CFS

BY RLS DATE 4/27/79 | BERGER ASSOCIATES | SHEET NO. 5 OF
CHKD. BY ____ DATE ____ | PROJECT D8490
SUBJECT MIDDLE CREEK DAM

TOP OF DAM RATING

$Q = CLH^{3/2}$ $C = 2.7$ (KING'S HDBK)

ELEV. 546.7

$2.7 \times 112 \times .2^{3/2} = 27$

$2.7 \times 25 \times .1^{3/2} = 2$ $\Sigma Q = 29$

ELEV. 546.9

$2.7 \times 112 \times .4^{3/2} = 77$

$2.7 \times 51 \times .2^{3/2} = 12$ $\Sigma Q = 89$

ELEV. 547.3

$2.7 \times 112 \times .8^{3/2} = 216$

$2.7 \times 46 \times .6^{3/2} = 58$

$2.7 \times 10 \times .4^{3/2} = 7$

$2.7 \times 11 \times .2^{3/2} = 3$ $\Sigma Q = 284$

ELEV. 547.8

$2.7 \times 112 \times 1.3^{3/2} = 448$

$2.7 \times 46 \times 1.1^{3/2} = 143$

$2.7 \times 16 \times .65^{3/2} = 23$

$2.7 \times 25 \times .45^{3/2} = 20$ $\Sigma Q = 634$

ELEV. 548.2

$2.7 \times 112 \times 1.7^{3/2} = 670$

$2.7 \times 46 \times 1.5^{3/2} = 228$

$2.7 \times 16 \times 1.05^{3/2} = 46$

$2.7 \times 25 \times .85^{3/2} = 53$

$2.7 \times 14 \times .25^{3/2} = 5$

$2.7 \times 30 \times .05^{3/2} = 1$ $\Sigma Q = 1003$

ELEV. 549

$2.7 \times 112 \times 2.5^{3/2} = 1195$

$2.7 \times 46 \times 2.3^{3/2} = 433$

$2.7 \times 16 \times 1.85^{3/2} = 109$

$2.7 \times 25 \times 1.65^{3/2} = 143$

$2.7 \times 19 \times 1.05^{3/2} = 41$

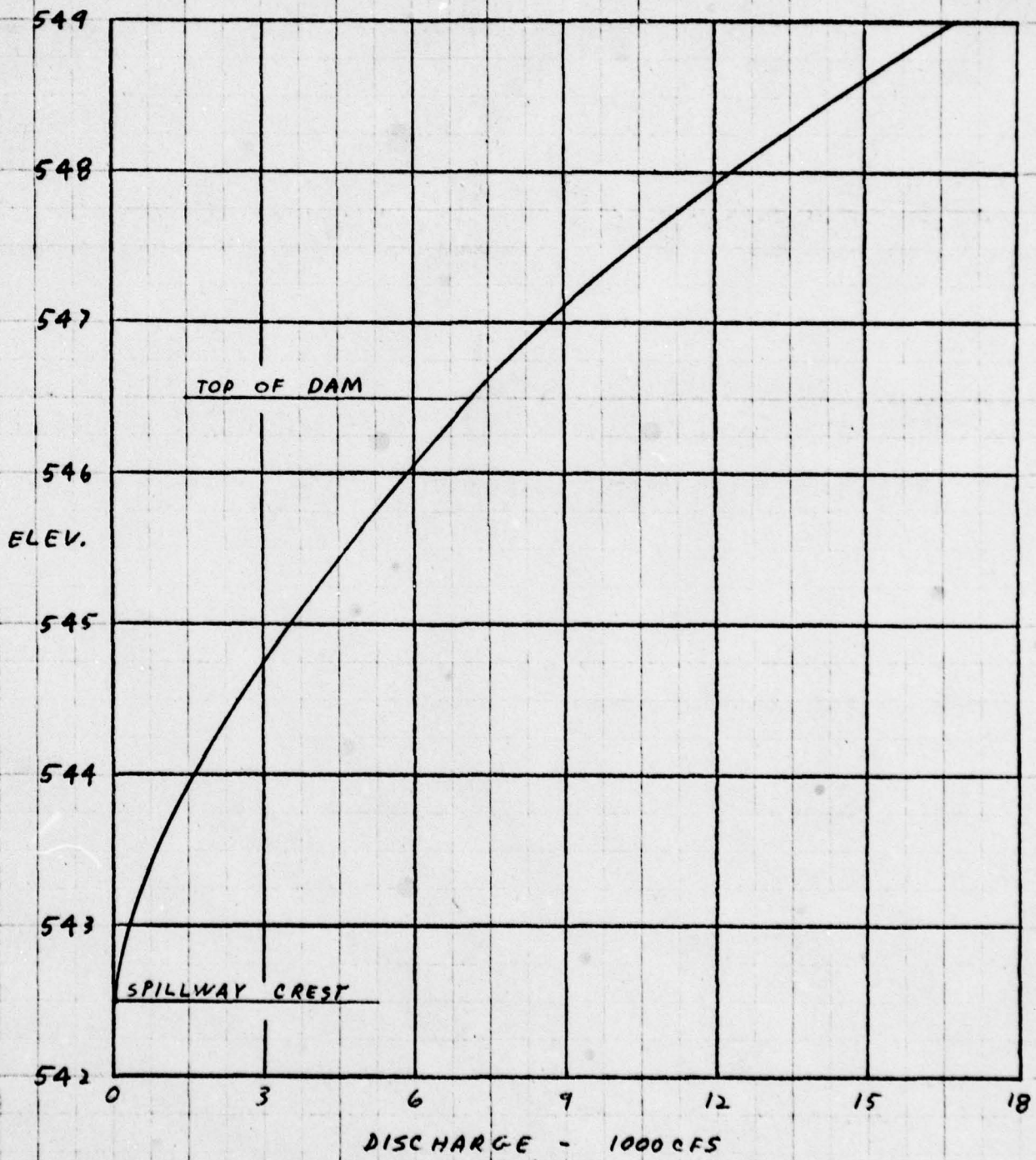
$2.7 \times 30 \times .85^{3/2} = 63$ $\Sigma Q = 1984$

BY RLS DATE 1/30/79 **BERGER ASSOCIATES** SHEET NO. 6 OF

CHKD. BY DATE PROJECT D8490

SUBJECT MIDDLE CREEK DAM

DISCHARGE RATING CURVE



BY RLS DATE 4/30/79 | BERGER ASSOCIATES | SHEET NO. 7 OF
CHKD. BY DATE | PROJECT D849C
SUBJECT MIDDLE CREEK DAM

SIZE CLASSIFICATION

MAXIMUM STORAGE = 3030 ACRE-FEET
MAXIMUM HEIGHT = 18 FEET
SIZE CLASSIFICATION IS "INTERMEDIATE"

HAZARD CLASSIFICATION

SEVERAL HOUSES ARE LOCATED ALONG THE DOWNSTREAM CHANNEL.
USE "HIGH"

RECOMMENDED SPILLWAY DESIGN FLOOD

THE ABOVE CLASSIFICATIONS INDICATE USE OF AN SDF EQUAL TO THE PROBABLE MAXIMUM FLOOD

BY RLS DATE 4/30/79 | BERGER ASSOCIATES | SHEET NO. 8 OF
CHKD. BY DATE | PROJECT D8490
SUBJECT MIDDLE CREEK DAM

HEC-1 DATA

DRAINAGE AREA = 7.8 SQ. MI.

SUSQUEHANNA BASIN REGION 15 C

C_P = .82

C_T = 2.78

LONGEST WATER COURSE = 5.49 MI.

LENGTH TO CENTROID = 1.89 MI.

$$T_P = C_T (L \times L_{CA})^{.3}$$

T_P = 5.6

RAINFALL (HMR - 33)

INDEX (200 SQ.MI. - 24 HR.) = 23.4"

ZONE 6

INCREMENTAL RAINFALL

6 HR	=	113 %
12 HR	=	123 %
24 HR	=	132 %
48 HR	=	143 %

PLANIMETERED AREAS (FROM QUAD SHEETS)

ELEV: 542.5	=	365 ACRES
560	=	1123 ACRES

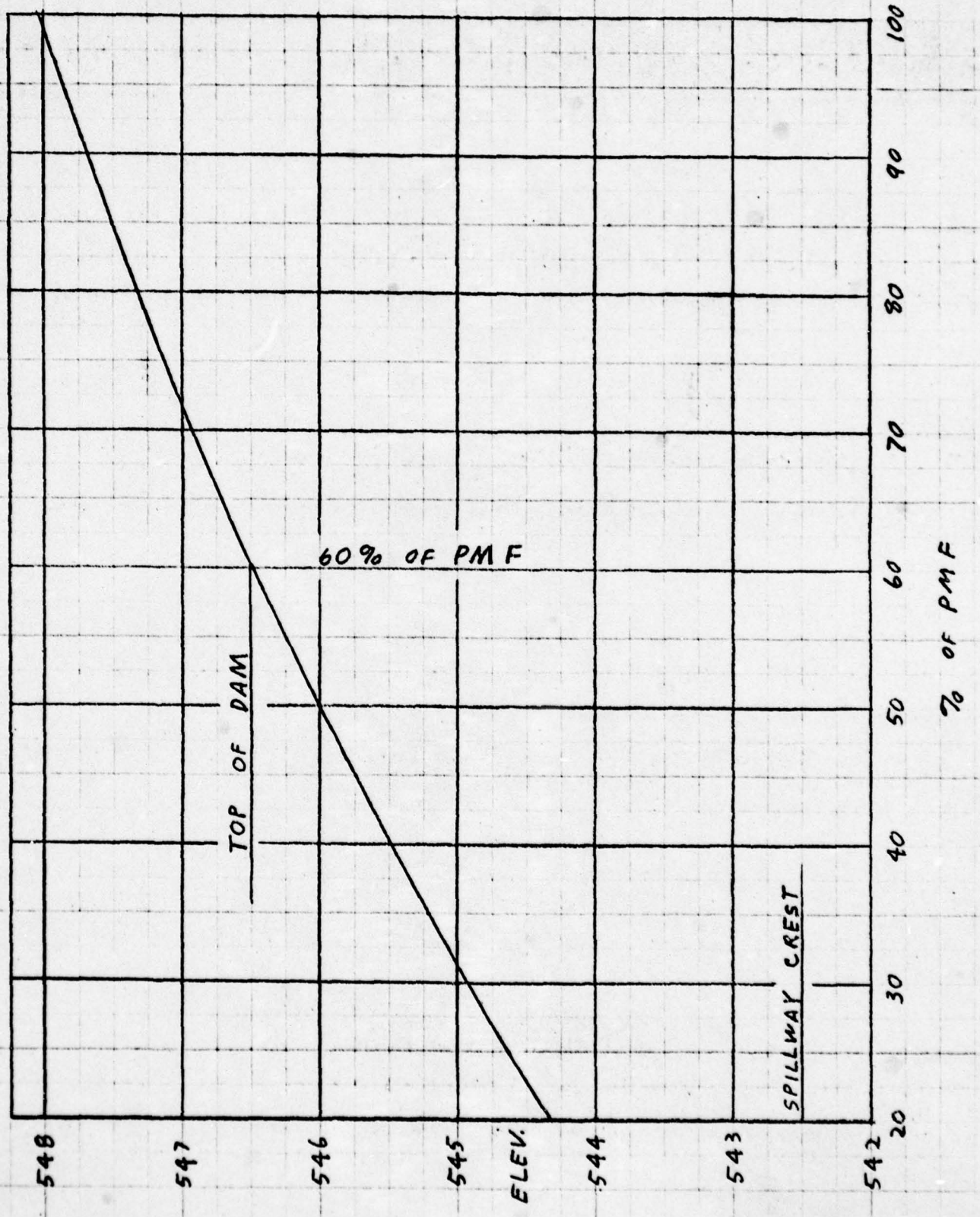
ZERO STORAGE ELEVATION

ELEV. = 542.5 - (STORAGE X 3/AREA)

= 531.8

BY RLS DATE 4/30/79 BERGER ASSOCIATES SHEET NO. 1 OF
CHKD. BY DATE PROJECT D 8490
SUBJECT MIDDLE CREEK DAM

SPILLWAY CAPACITY CURVE



FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79

```
**********
     1          A1   MIDDLE CREEK DAM  ****  MIDDLE CREEK
     2          A2   CLAY TWP., LANCASTER COUNTY, PA.
     3          A3   NDI # PA-00731    PA DER # 36-259
     4          B  300    0   15    0    0    0    0    0   -4    0
     5          B1   5
     6          J    1    9    1
     7          J1   1   .9   .8   .7   .6   .5  .35  .25  .15
     8          K        1                        1
     9          K1            INFLOW HYDROGRAPH
    10          M    1    1  7.8                             1
    11          P        23.4  113  123  132  143
    12          I                                  1  .05
    13          W  5.6  .82
    14          X -1.5 -.05    2
    15          K    1    2                        1
    16          K1            RESERVOIR ROUTING
    17          Y                   1
    18          Y1   1                                 1300   -1
    19          Y4 542.5  543 543.5  544 544.5  545 545.5  546 546.5 546.7
    20          Y4 546.9 547.3 547.8 548.2  549
    21          Y5   0  310  879 1615 2488 3520 4626 5839 7125 7694
    22          Y5 8308 9648 11499 13121 16741
    23          $A   0  365 1123
    24          $E 531.8 542.5  560
    25          $$ 542.5
    26          $D 546.5
    27          K   99.
```

1 PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

RUNOFF HYDROGRAPH AT 1
ROUTE HYDROGRAPH TO 2
END OF NETWORK

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE= 79/04/30.
TIME= 08.09.51.

MIDDLE CREEK DAM **** MIDDLE CREEK
CLAY TWP., LANCASTER COUNTY, PA.
NDI # PA-00731 PA DER # 36-259

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
3	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 0 LRTIO= 1

MIDDLE CREEK DAM #### MIDDLE CREEK
CLAY TWP., LANCASTER COUNTY, PA.
NDI # PA-00731 PA DER # 36-259

JOB SPECIFICATION

NO	NWR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1
RTIOS= 1.00 .90 .80 .70 .60 .50 .35 .25 .15

########## ########## ########## ########## ##########

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	7.80	0.00	7.80	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.40	113.00	123.00	132.00	143.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 5.60 CP= .82 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 64 END-OF-PERIOD ORDINATES, LAG= 5.59 HOURS, CP= .81 VOL= 1.00

9.	35.	70.	111.	155.	200.	247.	294.	341.	388.
434.	480.	524.	568.	611.	651.	686.	713.	733.	747.
755.	758.	756.	749.	737.	721.	700.	674.	642.	603.
550.	492.	438.	390.	347.	309.	275.	245.	218.	194.
173.	154.	137.	122.	109.	97.	86.	77.	68.	61.
54.	48.	43.	38.	34.	30.	27.	24.	21.	19.
17.	15.	13.	12.						

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM 26.77 24.35 2.42 493454.
(680.)(619.)(61.)(13973.06)

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

RESERVOIR ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	1300.	-1

STAGE	542.50	543.00	543.50	544.00	544.50	545.00	545.50	546.00	546.50	546.70
	546.90	547.30	547.80	548.20	549.00					
FLOW	0.00	310.00	879.00	1615.00	2486.00	3520.00	4626.00	5839.00	7125.00	7694.00
	8308.00	9648.00	11499.00	13121.00	16741.00					
SURFACE AREA=	0.	365.	1123.							
CAPACITY=	0.	1302.	13717.							
ELEVATION=	532.	543.	560.							

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
542.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
546.5	0.0	0.0	0.

PEAK OUTFLOW IS 12460. AT TIME 46.25 HOURS

PEAK OUTFLOW IS 11100. AT TIME 46.25 HOURS

PEAK OUTFLOW IS 9748. AT TIME 46.50 HOURS

PEAK OUTFLOW IS 8410. AT TIME 46.50 HOURS

PEAK OUTFLOW IS 7094. AT TIME 46.50 HOURS

PEAK OUTFLOW IS 5855. AT TIME 46.75 HOURS

PEAK OUTFLOW IS 4010. AT TIME 46.75 HOURS

PEAK OUTFLOW IS 2773. AT TIME 47.00 HOURS

PEAK OUTFLOW IS 1559. AT TIME 47.25 HOURS

1 ********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5	RATIO 6	RATIO 7	RATIO 8	RATIO 9
				1.00	.90	.80	.70	.60	.50	.35	.25	.15
HYDROGRAPH AT	1	7.80	1	14209.	12788.	11367.	9946.	8525.	7104.	4973.	3552.	2131.
		(20.20)		(402.34)	(362.11)	(321.88)	(281.64)	(241.41)	(201.17)	(140.82)	(100.59)	(60.35)
ROUTED TO	2	7.80	1	12460.	11100.	9748.	8410.	7094.	5855.	4010.	2773.	1559.
		(20.20)		(352.83)	(314.32)	(276.03)	(238.14)	(200.88)	(165.79)	(113.54)	(78.52)	(44.13)

1 SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	542.48	542.50	546.50
	STORAGE	1296.	1302.	3028.
	OUTFLOW	0.	0.	7125.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	548.04	1.54	3843.	12460.	7.00	46.25	0.00
.90	547.69	1.19	3653.	11100.	6.25	46.25	0.00
.80	547.33	.83	3456.	9748.	5.25	46.50	0.00
.70	546.93	.43	3247.	8410.	3.75	46.50	0.00
.60	546.49	0.00	3022.	7094.	0.00	46.50	0.00
.50	546.01	0.00	2785.	5855.	0.00	46.75	0.00
.35	545.22	0.00	2416.	4010.	0.00	46.75	0.00
.25	544.64	0.00	2157.	2773.	0.00	47.00	0.00
.15	543.96	0.00	1870.	1559.	0.00	47.25	0.00

1**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

APPENDIX D

GEOLOGIC REPORT

GEOLOGIC REPORT

Bedrock - Dam and Reservoir

Formation Name: Gettysburg Formation (also called Hammer Creek Formation).

Lithology: Predominantly red to brown quartz sandstone with interbeds of quartz pebble conglomerate and some red shale. The sandstone beds are typically a few inches to a foot, or more, thick. Grain size ranges from very fine to coarse. Sand grains are angular to sub-rounded quartz, imbedded in a matrix of clay and hematite. The conglomerates consist of pebbles and cobbles of quartzite, vein quartz and sandstone in a matrix of coarse sandstone, clay and hematite. The shale beds are red, thin bedded, non-fissile, composed of clay, hematite and some calcite.

Structure

The dam is located near the northern side of the Newark-Gettysburg basin, often described as a half-graben, down faulted on the northern side. There is, however, no evidence for a fault in this area. The beds of the Gettysburg Formation strike nearly East-West and dip 35° to 55° North. No minor faulting has been reported at the dam site.

The dominant direction of air photo fracture traces is about N10°E. The course of Middle Creek is controlled by these fractures at the dam site.

Overburden

The valley of Middle Creek contains an unusual thickness of unconsolidated materials. The geologic map of the Womelsdorf Quadrangle relates these deposits to the talus that blankets the slopes of nearby South Mountain. Core borings at the site indicate that the deposits consist of sand, gravel and some clay and ore, twenty to forty feet thick. Some swamp deposits, silt, clay and organic muck locally overlies the sand and gravel.

On the valley sides five to ten feet of soil and weathered sandstone blocks overlie the bedrock.

Aquifer Characteristics

The rocks of the Gettysburg Formation are essentially impermeable, and all ground water movement is along bedding planes and fractures. Where the beds are fractured ground water movement can be quite free. Generally speaking the massive conglomerate and sandstone beds of the dam site seem to resist ground water movement.

Discussion

The sandstones and conglomerates of the Gettysburg Formation should be excellent dam foundation materials. Only minor amounts of carbonate cement are present, and continued ground water movement is unlikely to weaken the rock. Some leakage under the central section of the dam, along N-S fractures is possible, but it should not affect the soundness of the foundation.

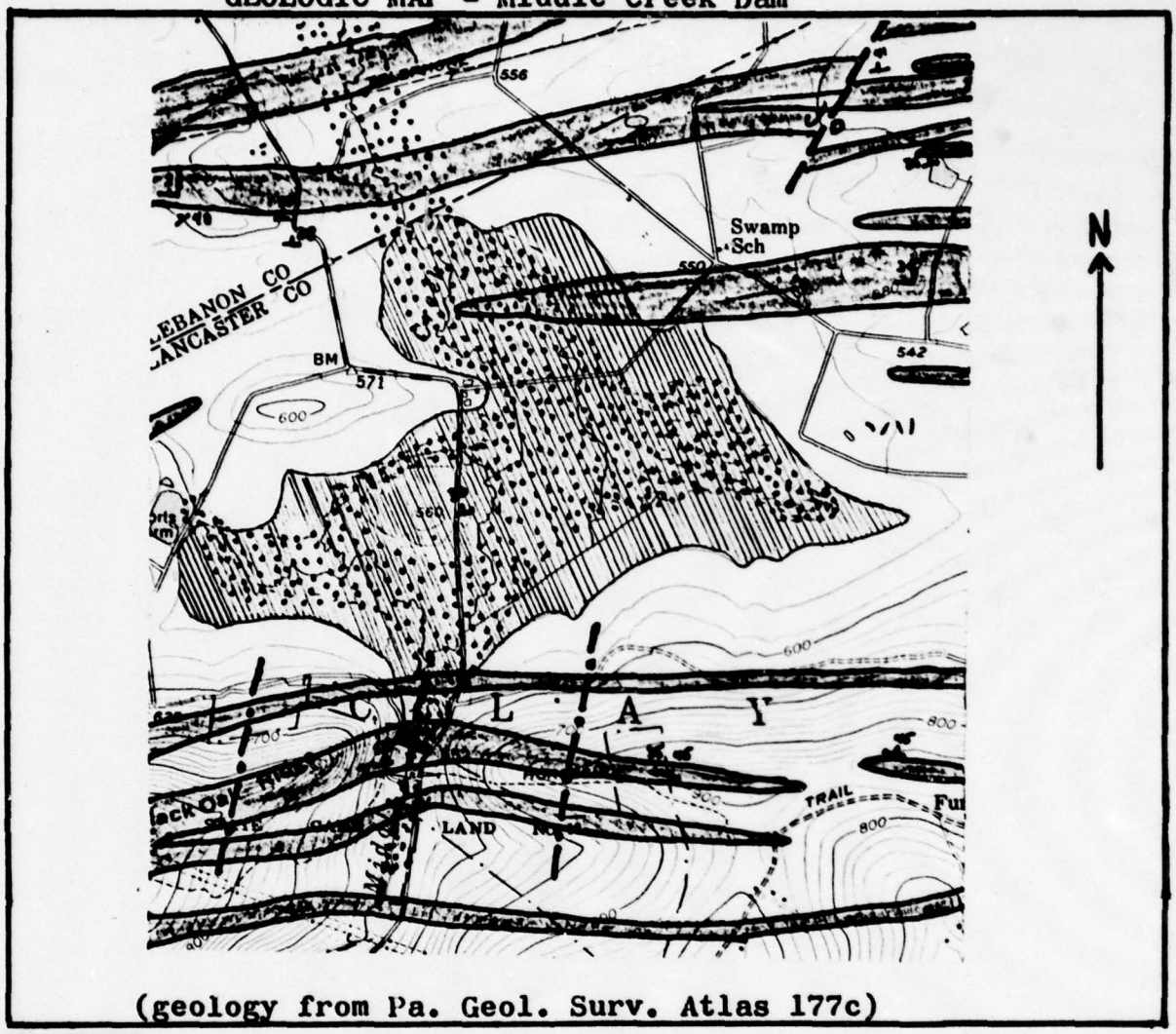
Sources of Information

1. Geyer, A.R., Buckwalter, T.V., McLaughlin, D.B., and Gray, C. (1963). "Geologic and Mineral Resources of the Womelsdorf Quadrangle". Pa. Geological Survey Atlas A177c.

2. Air Photos, scale 1:24,000, dated 1969.

3. Core boring data in file.

GEOLOGIC MAP - Middle Creek Dam



(geology from Pa. Geol. Surv. Atlas 177c)

unconsolidated deposits

Tgc — Gettysburg Fm.- quartz conglomerate

Tgs — Gettysburg Fm.- sandstone

fault

air photo fracture trace

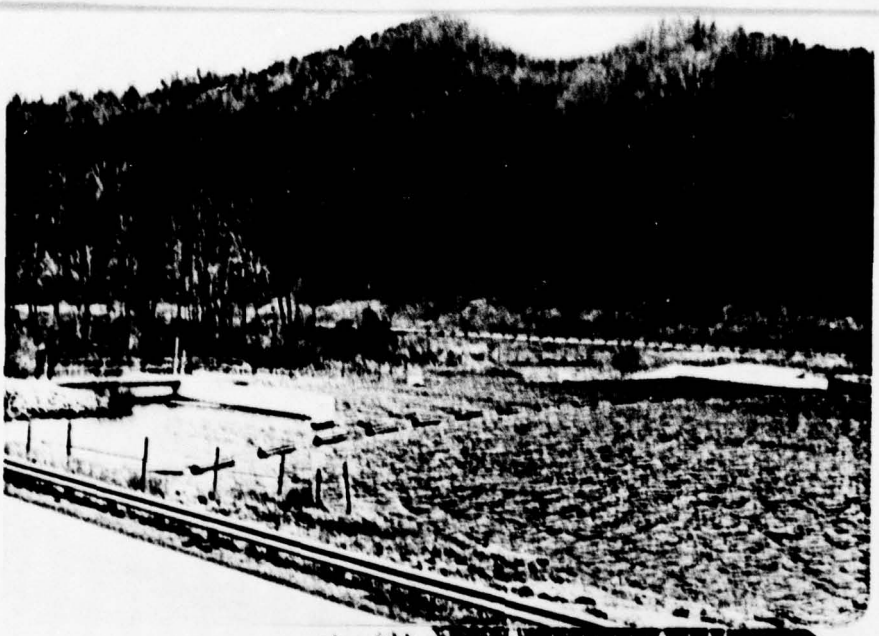
strike and dip

SCALE 1:24000

1 0 1 MILE

APPENDIX E

PHOTOGRAPHS

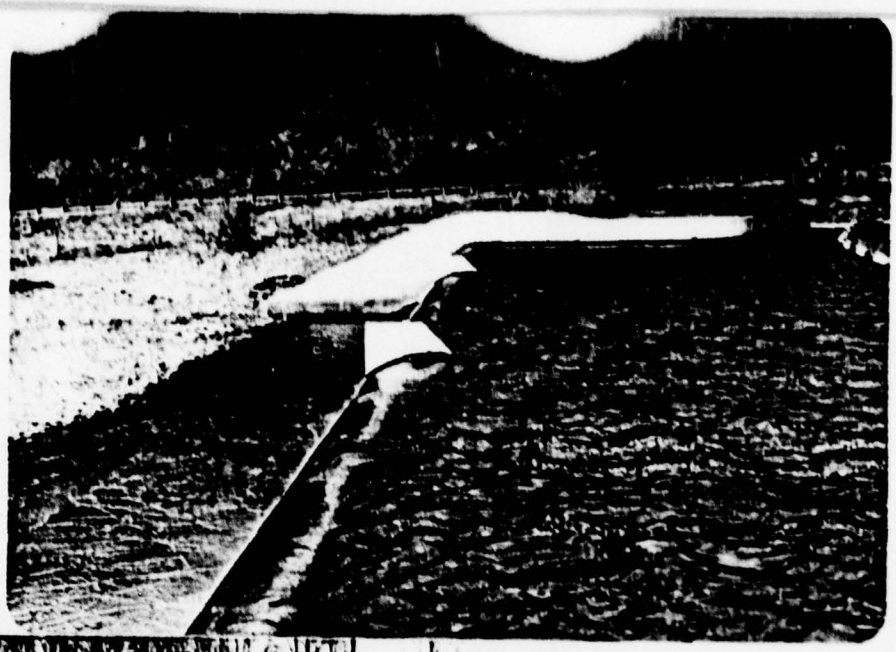


Forebay Walls

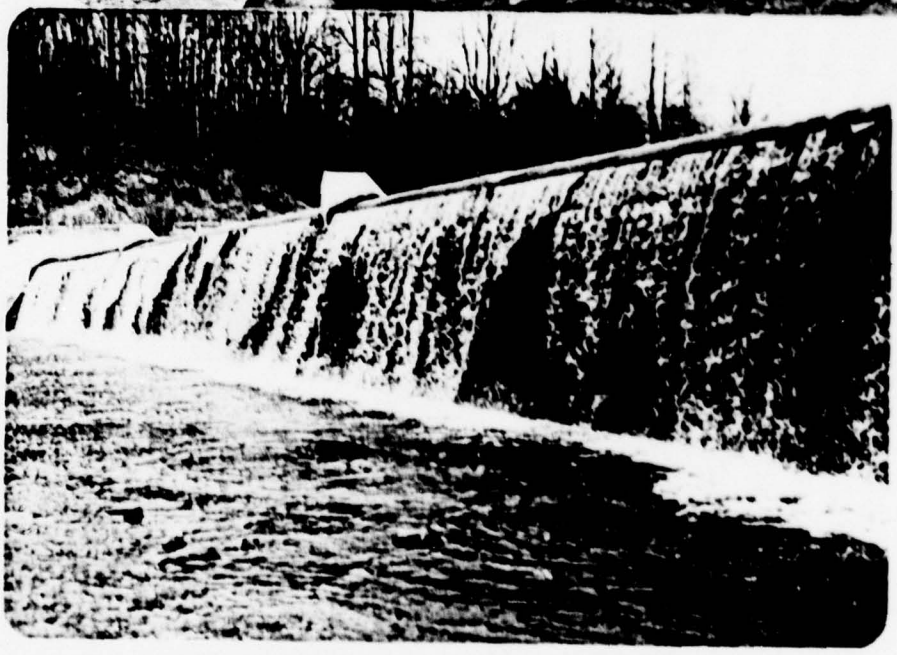
Left Abutment
Downstream

Left Abutment
Wet Area of
Sidehill

PA-731
PLATE E-1



Spillway Overflow
and
Ice Breakers



Downstream View
of
Spillway

Left Side of
Spillway
With
Control Structure

PA-731
PLATE E-11

Reservoir

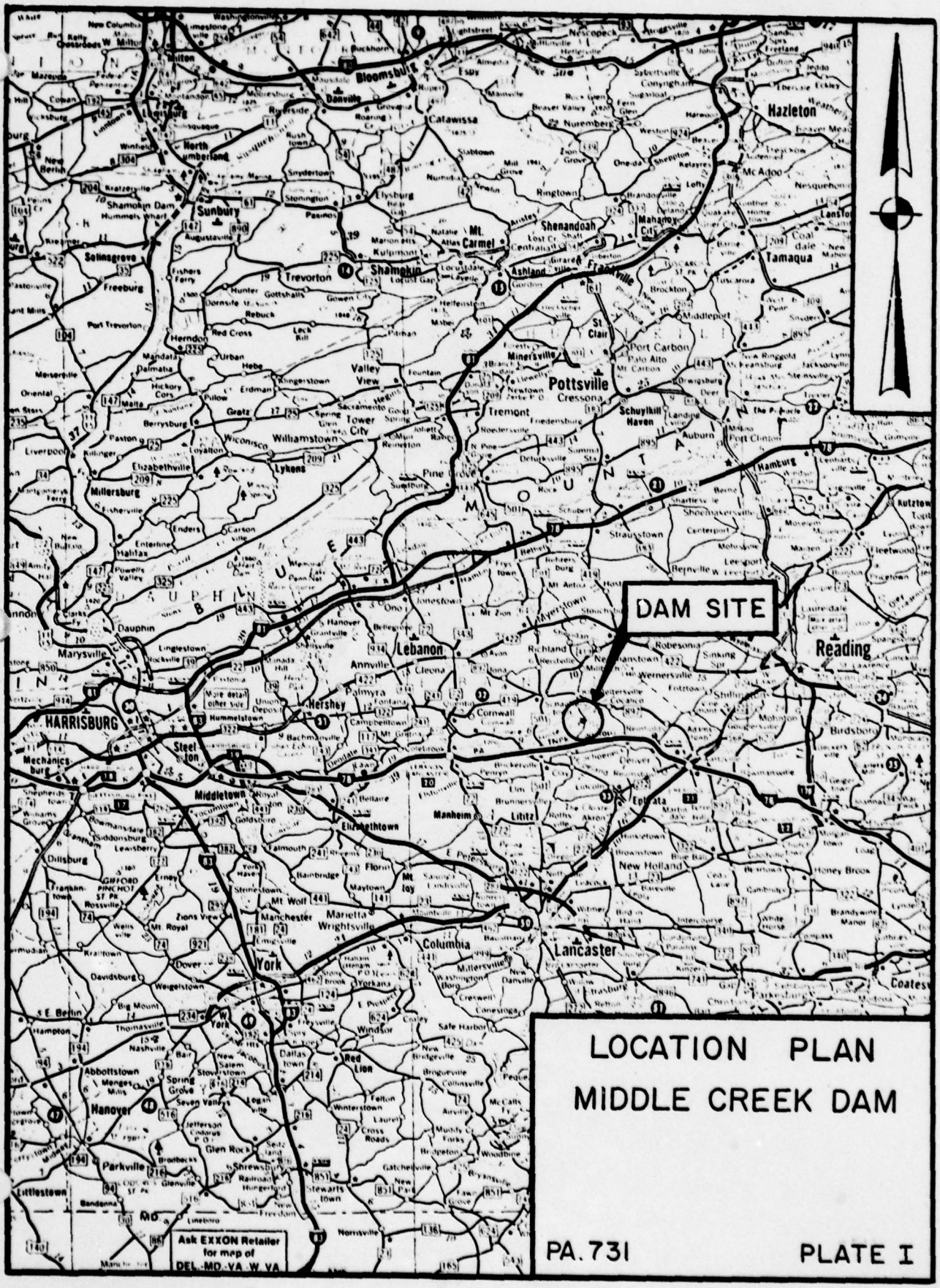
Downstream Channel

Two Span Bridge
Downstream Channel

PA-731
PLATE E-III

APPENDIX F

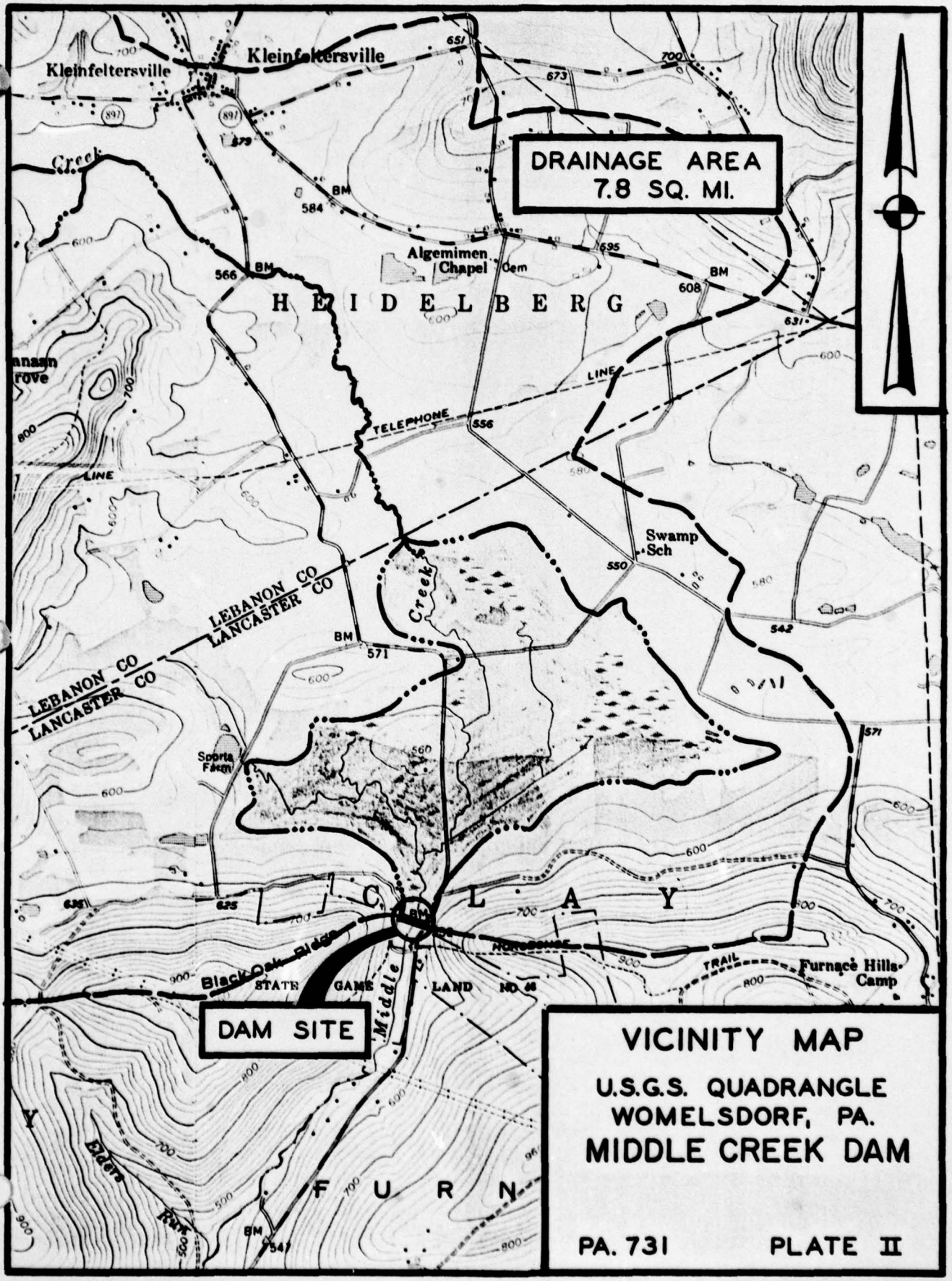
PLATES

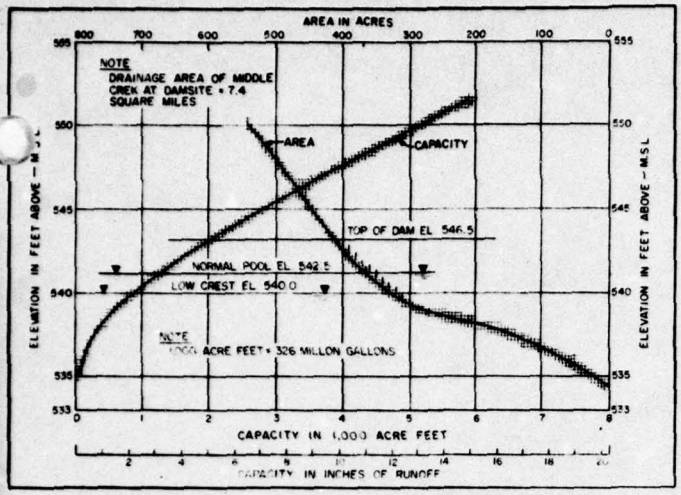


LOCATION PLAN
MIDDLE CREEK DAM

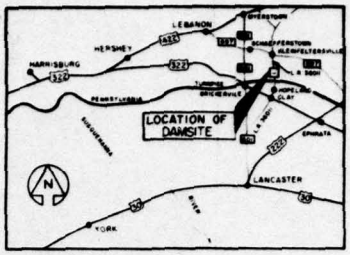
PA. 731

PLATE I


Kleinfeltersville
Kleinfeltersville
DRAINAGE AREA
7.8 SQ. MI.
Algemimen
Chapel
Cem
H E I D E L B E R G
TELEPHONE LINE
LEBANON CO
LANCASTER CO
Swamp
Sch
Creek
Sports
Farm
C L A Y
Black Oak Ridge
STATE GAME LAND NO 46
Middle
Furnace Hills
Camp
TRAIL
DAM SITE
F U R N
Elders
Run
VICINITY MAP
U.S.G.S. QUADRANGLE
WOMELSDORF, PA.
MIDDLE CREEK DAM
PA. 731
PLATE II

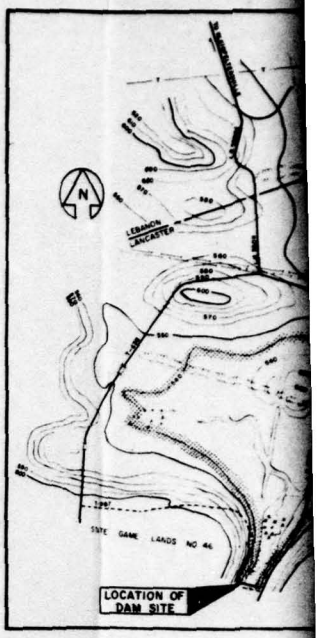


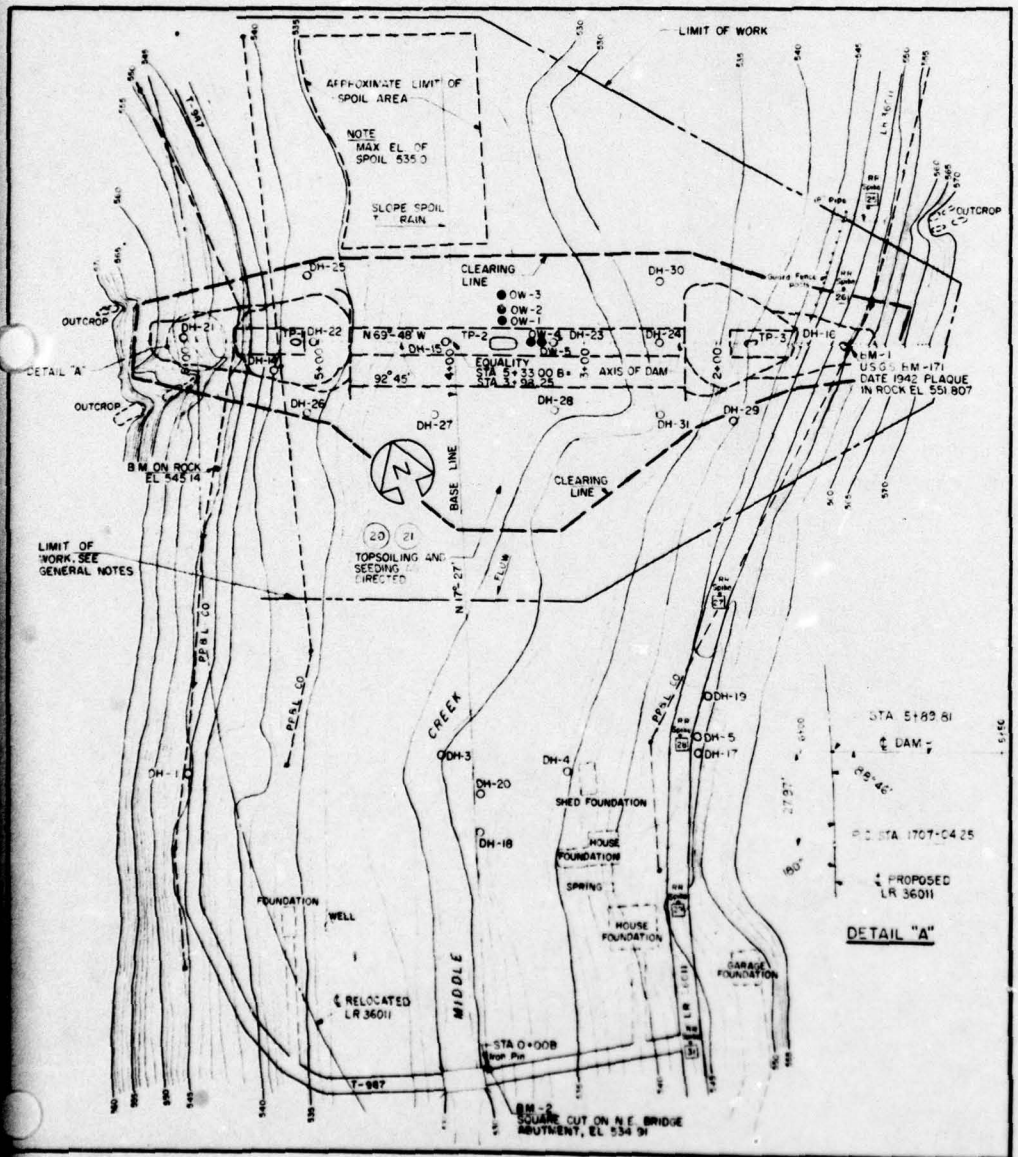
AREA-CAPACITY CURVES



LOCATION MAP

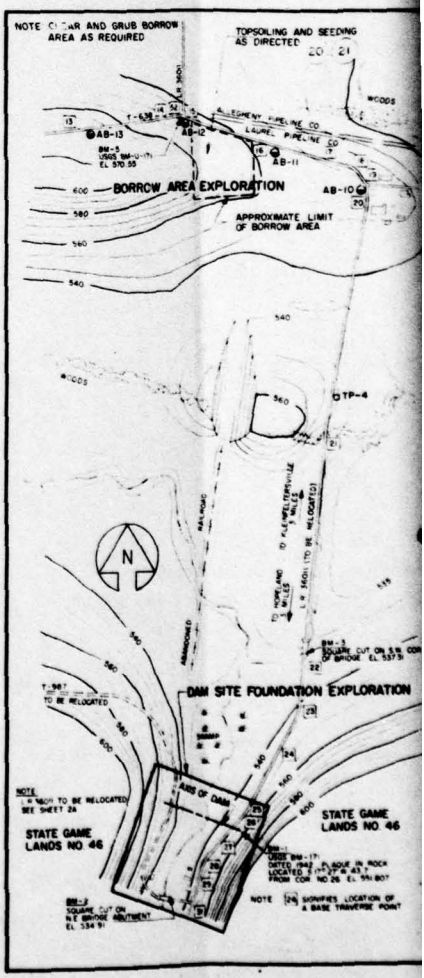
SCALE: 1" = 10'





PROJECT LAYOUT
DAM SITE TOPOGRAPHY
FOUNDATION EXPLORATION PLAN

SCALE: 1" = 50'



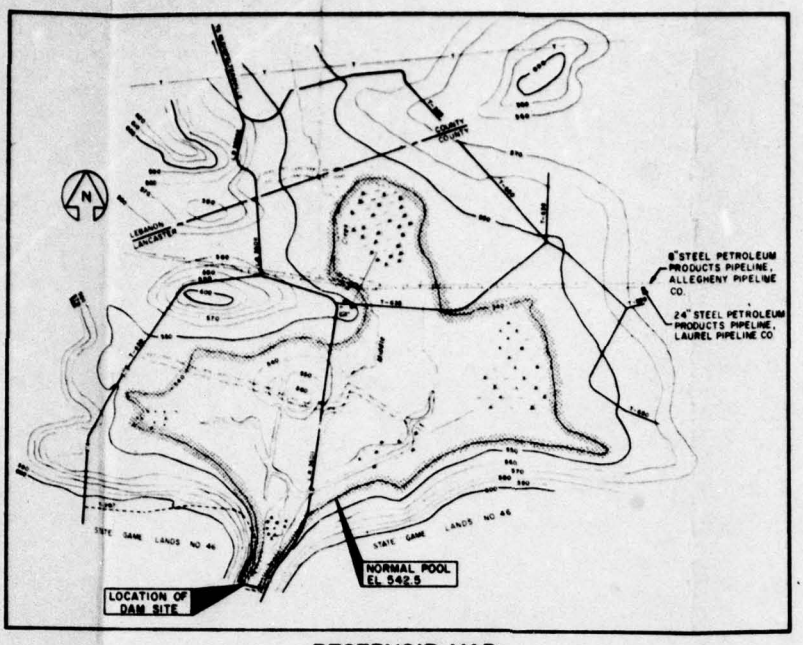
SITE MAP

SCALE: 1" = 400'

LEGEND

- DH-2 — DRILL HOLE LOCATION
- AB-12 — AUGER HOLE LOCATION
- OW-4 — OBSERVATION WELL LOCATION
- TP-1 — TEST PIT LOCATION
- POWER OR TELEPHONE POLE
- BASE TRAVERSE POINT

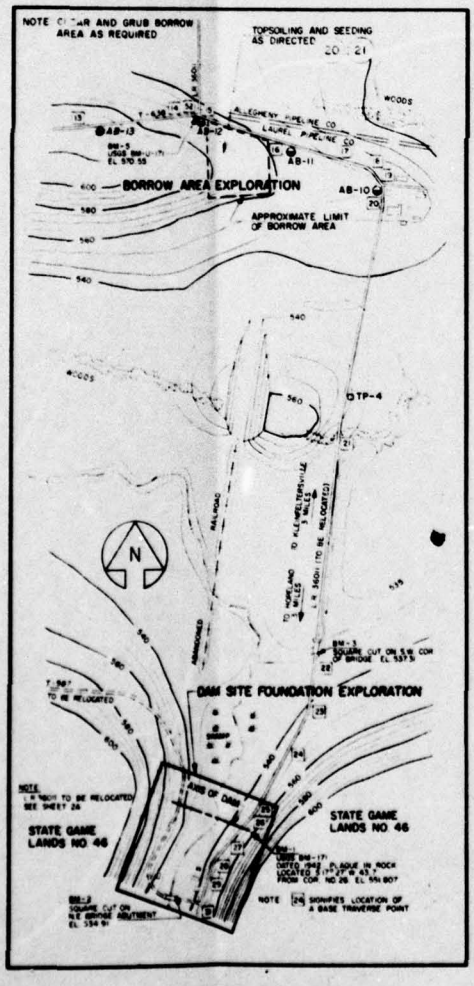
MAP



RESERVOIR MAP

1000' 500' 0 1000' 2000'

SCALE 1" = 1000'



SITE MAP

400' 200' 0 400' 800'

SCALE: 1" = 400'

JAN 12 1971

GENERAL NOTES

1. FOR LOGS OF DRILL HOLES AND TEST PITS SEE SHEETS 3 AND 4
2. TOPOGRAPHY BASED ON FIELD SURVEY BY PENNSYLVANIA GAME COMISSION, 1965. ELEVATIONS BASED ON USGS BENCH MARK BM-171, SHOWN ON TOPOGRAPHY.
3. UTILITY RELOCATIONS BY OTHERS. FOR RELOCATION OF L.R. 36011, SEE SHEET 2A.
4. THE LIMIT OF WORK AREA AS SHOWN IS APPROXIMATE AND MAY BE EXTENDED SUBJECT TO APPROVAL OF THE ENGINEER AND THE GAME COMMISSION.
5. FOR LIMIT OF WORK AREA FOR CONSTRUCTION OF L.R. 36011 SEE HIGHWAY DRAWINGS AND/OR SPECIFICATIONS
6. EXTENT OF CLEARING AS SHOWN IS THAT REQUIRED FOR DAM CONSTRUCTION AND WILL BE PAID FOR UNDER ITEM (2). FOR REQUIRED CLEARING FOR CONSTRUCTION OF L.R. 36011 SEE HIGHWAY DRAWINGS AND/OR SPECIFICATIONS.
7. FOR OTHER GENERAL NOTES SEE SHEET 5.
8. CLEARING AND GRUBBING BORROW AREA WILL BE PAID FOR UNDER ITEM (2)

REVISED

SYMBOL	CORRECTIONS

APPROVALS

APPROVED
PENNSYLVANIA GAME COMMISSION

APPROVED
DIRECTOR, BUREAU OF ENGINEERING AND CONSTRUCTION
DEPARTMENT OF PROPERTY AND SUPPLIES

APPROVAL RECOMMENDED
CHIEF, ENGINEERING DIVISION - BUREAU OF ENGINEERING AND CONSTRUCTION
DEPARTMENT OF PROPERTY AND SUPPLIES

SUBMITTED BY
GARRETT FLEMING CORDERY & CARPENTER, INC.

COMMONWEALTH OF PENNSYLVANIA
RAYMOND P SHAFER, GOVERNOR

PENNSYLVANIA GAME COMMISSION
GLENN L BOWERS, EXECUTIVE DIRECTOR

HARRISBURG PENNSYLVANIA

PROJECT LAYOUT, FOUNDATION EXPLORATION LOCATION AND SITE MAPS, AREA CAPACITY CURVE

PROJECT NO. 500 2-12 B (46-70)

CONSTRUCTION OF MIDDLE CREEK DAM
MIDDLE CREEK WATERFOWL AREA
LANCASTER COUNTY, PENNSYLVANIA
FOR THE PENNSYLVANIA GAME COMMISSION

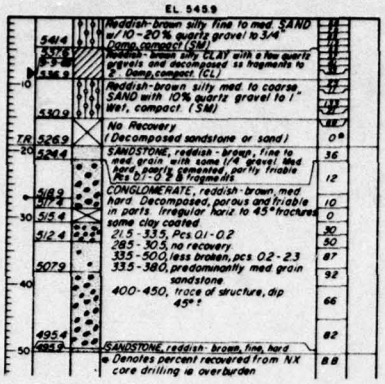
DES.	GARRETT FLEMING CORDERY & CARPENTER, INC.	SHEET NO.
DRAWN	ENGINEERS	2
AS SHOWN	HARRISBURG PENNSYLVANIA	

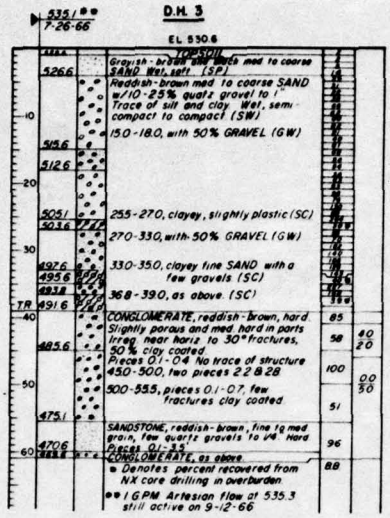
RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD, DEPARTMENT OF FORESTS & WATERS ON THE 23rd DAY OF MARCH 1971

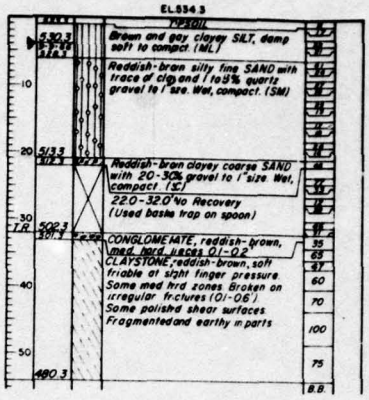
36-259-1

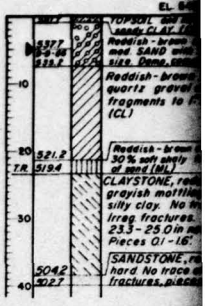
2

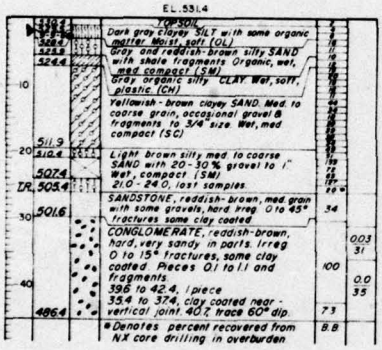
PA. 731
PLATE III

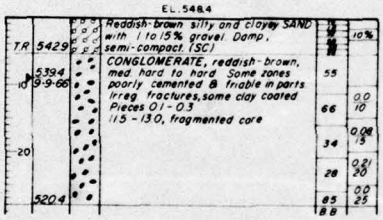


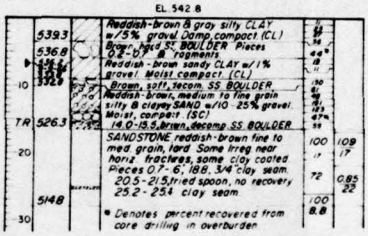


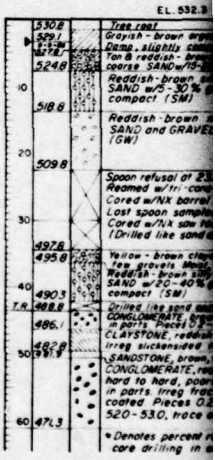


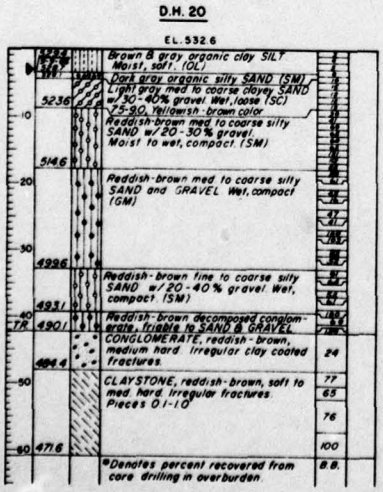




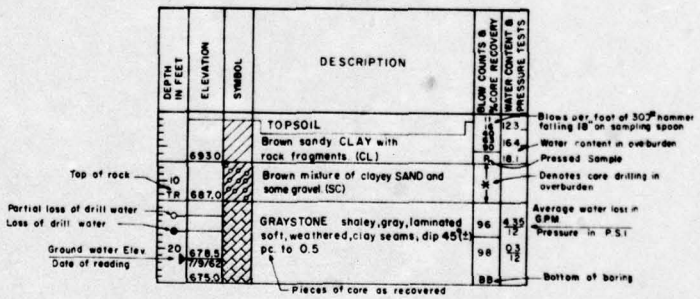








LEGEND



SYMBOLS

OVERBURDEN

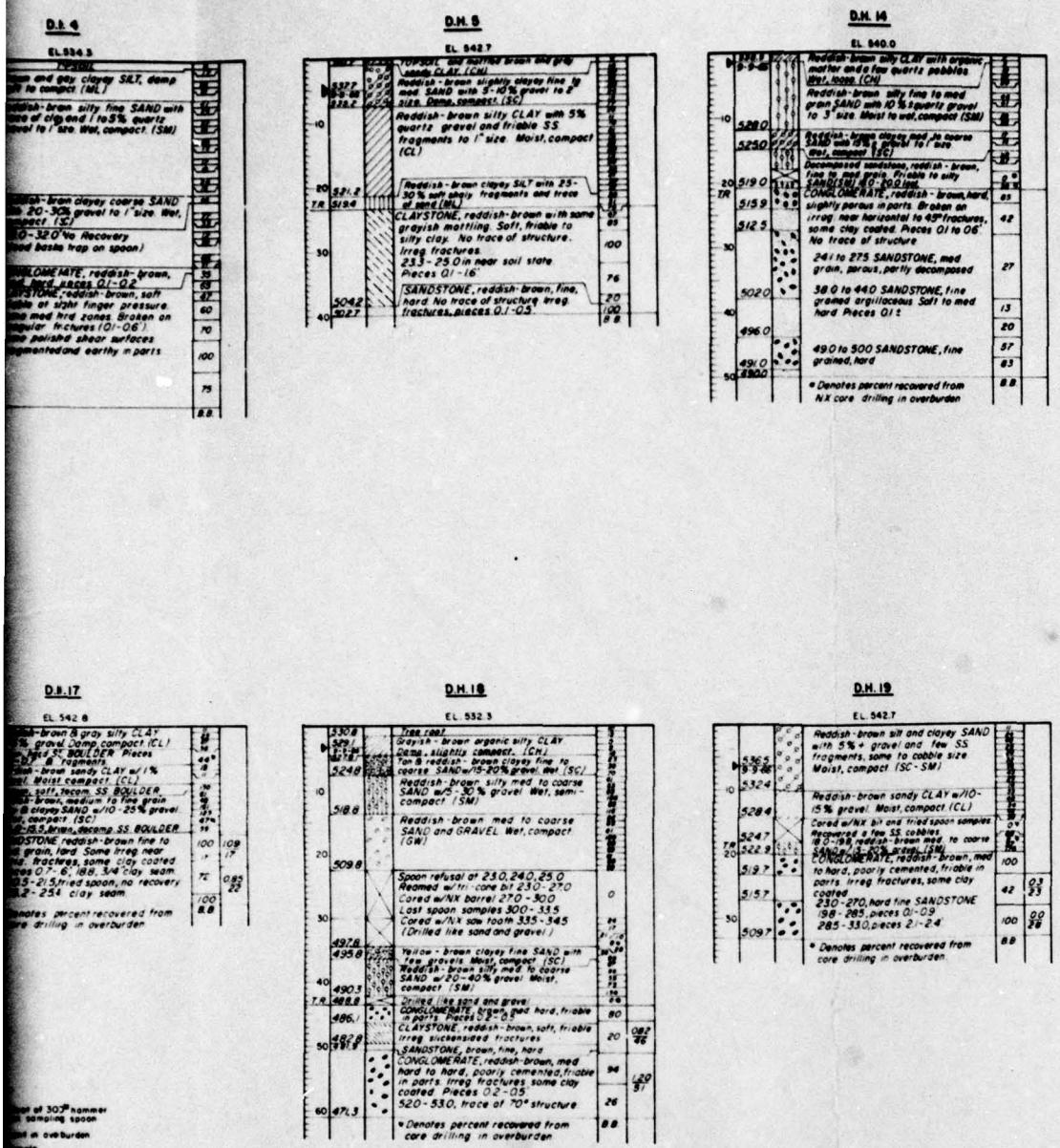
- TOPSOIL
- CH — SANDY CLAY (HIGHLY PLASTIC)
- CL — SILTY AND SANDY CLAY WITH OCCASIONAL GRAVEL
- ML — SANDY AND CLAYEY SILT OR SANDY AND CLAYEY SILT
- OL — ORGANIC SILT
- SC — CLAYEY SAND AND SILTY AND CLAYEY SAND WITH SOME GRAVEL AND COBBLES
- SM — SILTY FINE TO COARSE GRAIN SAND AND SILTY SAND WITH SOME GRAVELS
- GM — SILTY SAND AND GRAVEL
- SP — POORLY GRADED SAND
- SW — FINE TO COARSE GRAIN SAND WITH LITTLE OR NO FINES
- GW,GP — FINE TO COARSE GRAIN SAND AND GRAVEL AND SILTY SAND AND GRAVEL
- COBBLES AND BOULDERS OR LOOSE BEDROCK

ROCK

- CONGLOMERATE
- CONGLOMERATIC SANDSTONE
- SANDSTONE
- CLAYSTONE AND SANDY AND SILTY SHALE
- NO RECOVERY

GENERAL NOTES

1. DRILL HOLES (D.H.) WERE ACCOMPLIS… A 3" I.D. x 2.0" LONG SPOON (UNLESS… SAMPLES. THESE SAMPLE SPOONS… FALLING 18" HOWEVER IN SOME CAS… FACILITATE ADVANCING THE BORING… BIT UNLESS OTHERWISE SPECIFIED.
2. THE BORINGS INCLUDED ON THESE DR… IMMEDIATE AREA OF THE WORK. T… PRESENTED IN THE FOUNDATION EX…
3. LETTER SYMBOLS SUCH AS GC, SC, CL… SOIL CLASSIFICATION SYSTEM MIL-…
4. THE GROUND WATER LEVEL SHOWN O… WATER HAD STABILIZED IN THE HOL… NECESSARILY THE LEVEL AT WHICH… THE DRILLING OPERATION.
5. DESCRIPTION OF SOILS GIVEN ON THE… JAR SAMPLES. PRESENCE OF BOULDE… WAS A REFUSAL IN THE DRIVING OPE… BE NOTED, HOWEVER, THAT IN MANY … MAY HAVE BEEN PENETRATED BY DR… IN THE LOGS OF THE DRILL HOLES. … IN THE RIGHT HAND COLUMN OF THE … TO A COBBLE OR SMALL BOULDER.
6. WATER CONTENTS SHOWN IN RIGHT H… ARE THE WATER CONTENT (% OF DRY… ALL WATER CONTENTS ARE DETERM… UNLESS OTHERWISE NOTED.
7. TEST PITS (TP) ARE MACHINE DUG.



GENERAL NOTES

1. DRILL HOLES (D H) WERE ACCOMPLISHED BY DRIVE BORING PROCEDURE USING A 3" (O x 2.0" LONG SPOON (UNLESS OTHERWISE NOTED) FOR DISTURBED SAMPLES. THESE SAMPLE SPOONS WERE ADVANCED BY A 300# HAMMER FALLING 18" HOWEVER IN SOME CASES THE OVERBURDEN WAS CORED TO FACILITATE ADVANCING THE BORING. ROCK WAS CORED WITH A 2 1/8" (N x) BIT UNLESS OTHERWISE SPECIFIED.
2. THE BORINGS INCLUDED ON THESE DRAWINGS ARE THOSE IN OR NEAR THE IMMEDIATE AREA OF THE WORK. THE LOCATION OF THESE BORINGS IS PRESENTED IN THE FOUNDATION EXPLORATION SITE AND LOCATION MAPS
3. LETTER SYMBOLS SUCH AS GC, SC, CL, ARE IN ACCORDANCE WITH THE UNIFIED SOIL CLASSIFICATION SYSTEM MIL-STD-619(A) OF THE CORPS OF ENGINEERS, U.S. ARMY.
4. THE GROUND WATER LEVEL SHOWN ON THE LOGS REPRESENTS THE LEVEL AT WHICH WATER HAD STABILIZED IN THE HOLE PRIOR TO REMOVAL OF CASING, IT IS NOT NECESSARILY THE LEVEL AT WHICH WATER WAS FIRST ENCOUNTERED IN THE DRILLING OPERATION.
5. DESCRIPTION OF SOILS GIVEN ON THE LOGS IS BASED ON EXAMINATION OF QUART SIZE JAR SAMPLES. PRESENCE OF BOULDERS HAS BEEN NOTED ON THE LOGS WHEN THERE WAS A REFUSAL IN THE DRIVING OPERATION WITH SUBSEQUENT CORING. IT SHOULD BE NOTED, HOWEVER, THAT IN MANY INSTANCES COBBLES, OR EVEN SMALL BOULDERS MAY HAVE BEEN PENETRATED BY DRIVING AND MAY NOT THEREFORE BE REFLECTED IN THE LOGS OF THE DRILL HOLES. HIGH RESISTANCE TO DRIVING AS RECORDED IN THE RIGHT HAND COLUMN OF THE LOGS IS CONSIDERED IN MANY TO BE DUE TO A COBBLE OR SMALL BOULDER.
6. WATER CONTENTS SHOWN IN RIGHT HAND COLUMN OF DRILL HOLE AND TEST PIT LOGS ARE THE WATER CONTENT (% OF DRY WEIGHT) OF THE TOTAL SAMPLE SOIL RECOVERED. ALL WATER CONTENTS ARE DETERMINED ON MINUS 3/4 MATERIAL UNLESS OTHERWISE NOTED.
7. TEST PITS (TP) ARE MACHINE DUG.

ROCK

- CONGLOMERATE
- CONGLOMERATIC SANDSTONE
- SANDSTONE
- CLAYSTONE AND SANDY AND SILTY SHALE
- NO RECOVERY

REVISED

DYNAMIC DIRECTIONS 36-259-3

APPROVED

RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD, DEPARTMENT OF FORESTS & WATERS ON THIS 2 DAY OF [illegible] A.D. 19[illegible]

[illegible] File Clerk

APPROVED PENNSYLVANIA GAME COMMISSION

APPROVED DIRECTOR, BUREAU OF ENGINEERING AND CONSTRUCTION DEPARTMENT OF PROPERTY AND SUPPLIES

APPROVAL RECOMMENDED CHIEF, ENGINEERING DIVISION - BUREAU OF ENGINEERING AND CONSTRUCTION DEPARTMENT OF PROPERTY AND SUPPLIES

SUBMITTED BY GANNETT FLEMING CORDRY & CARPENTER, INC.

JAN 1 1971

COMMONWEALTH OF PENNSYLVANIA
RAYMOND P. SHAFER, GOVERNOR
PENNSYLVANIA GAME COMMISSION
GLENN L. ROWERS, EXECUTIVE DIRECTOR
HARRISBURG PENNSYLVANIA

FOUNDATION EXPLORATION
LOGS OF CORE BORINGS

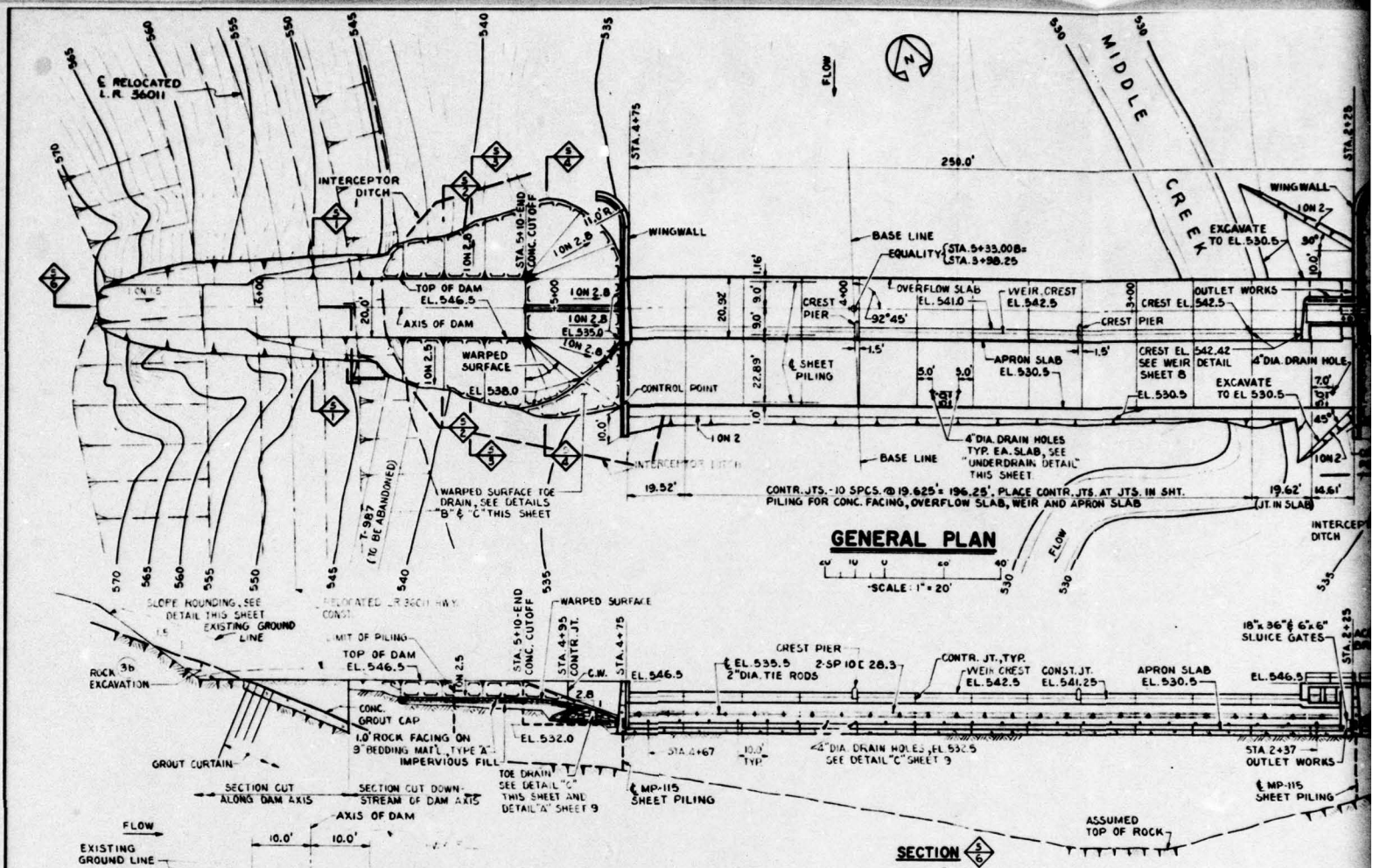
PROJECT NO. 500 2-12 B (46-70)

CONSTRUCTION OF MIDDLE CREEK DAM
MIDDLE CREEK WATERFOWL AREA
LANCASTER COUNTY, PENNSYLVANIA
FOR THE PENNSYLVANIA GAME COMMISSION

DESIGN BY DS	"GANNETT FLEMING CORDRY & CARPENTER, INC.	SHEET NO.
CHECKED BY E.F.	ENGINEERS	3
DATE AS SHOWN	HARRISBURG PENNSYLVANIA	

2

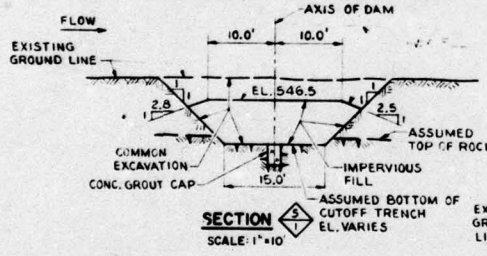
PA. 731
PLATE IV



GENERAL PLAN

SECTION 3/6

SCALE: 1" = 20'



SECTION 3/1

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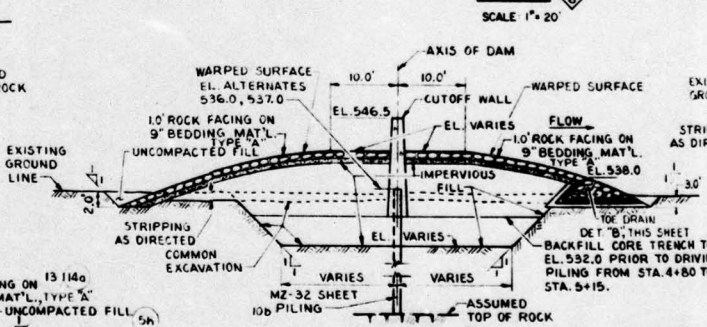

SECTION 3/4

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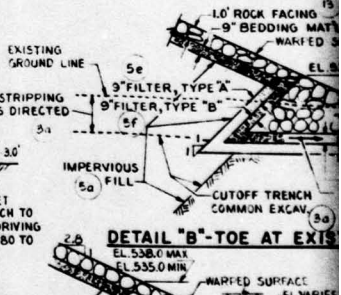
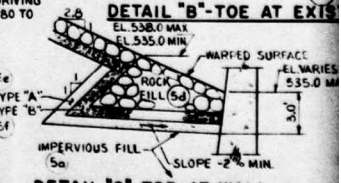
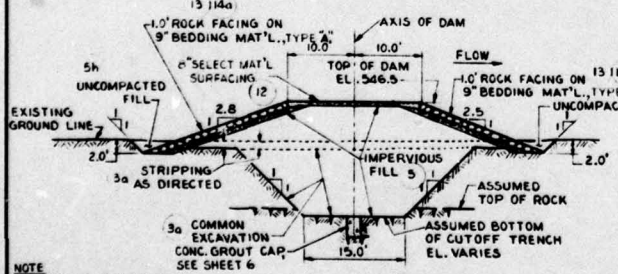


DETAIL "B"-TOE AT EXIS



DETAIL "C"-TOE AT WALL

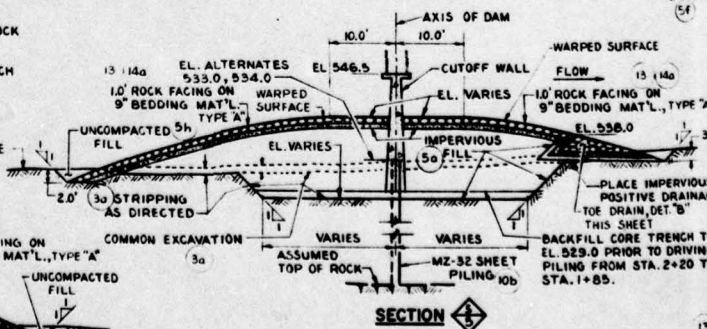
TOE DRAIN DETAILS



NOTE
FOR TOP OF DAM DETAILS, SEE DETAIL "A", THIS SHEET.

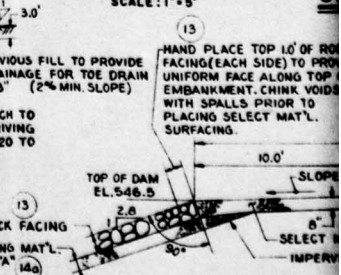
SECTION 3/2

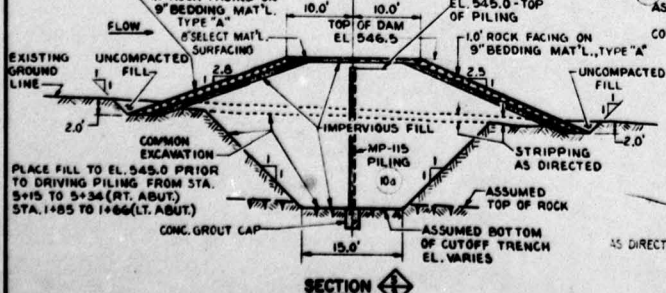
SCALE: 1" = 10'



SECTION 3/5

SCALE: 1" = 10'





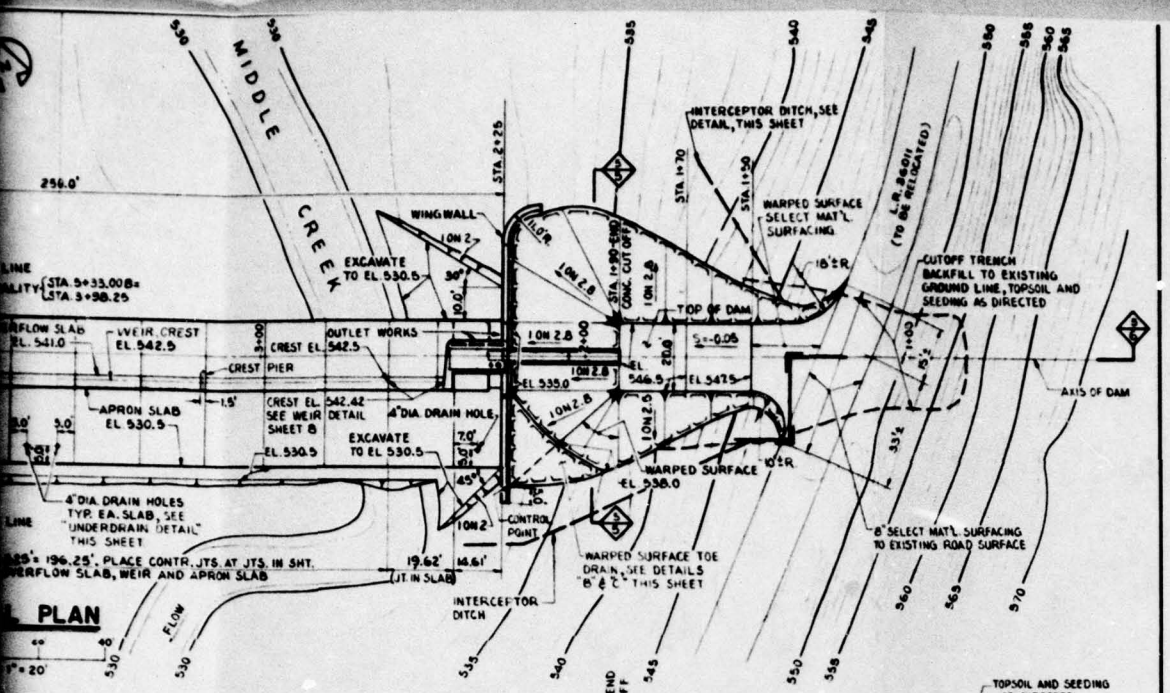
SECTION 3/3

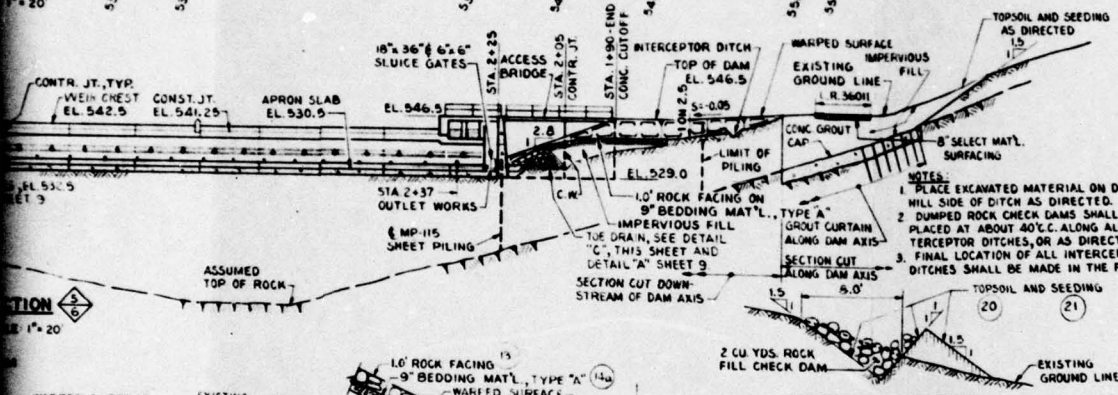
SCALE: 1" = 10'

SLOPE ROUNDING DETAIL

NO SCALE

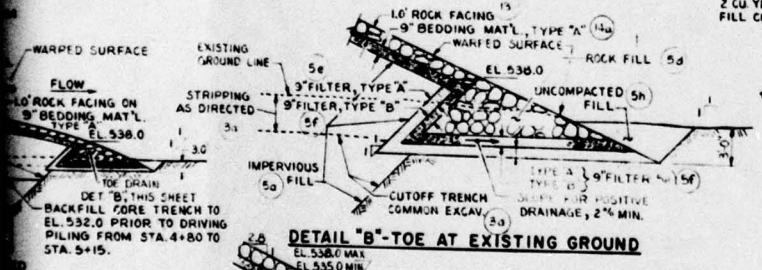
TYPICAL TOP



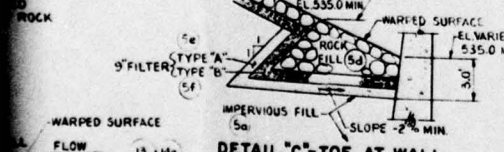


TYPICAL SECTION INTERCEPTOR DITCH (15)

SCALE: 1" = 5'



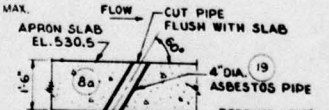
DETAIL "B" - TOE AT EXISTING GROUND



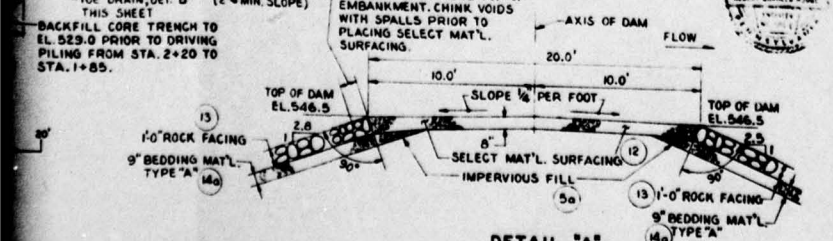
DETAIL "C" - TOE AT WALL

TOE DRAIN DETAILS

SCALE: 1" = 5'



UNDERDRAIN DETAIL



DETAIL "A" TYPICAL TOP OF DAM SECTION

SCALE: 1" = 4'

REVISED

DIVISION	CORRECTIONS

APPROVALS

APPROVED: RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD, DEPARTMENT OF FORESTS & WATERS ON THIS DAY OF ... A.D. 19...

APPROVED: BUREAU OF ... DEPARTMENT OF PROPERTY AND SUPPLIES

APPROVED: RECOMMENDED ONLY, ENGINEERING DIVISION - BUREAU OF ENGINEERING AND CONSTRUCTION DEPARTMENT OF PROPERTY AND SUPPLIES

SUBMITTED BY: GARNETT FLEMING CORDRY & CARPENTER, INC.

COMMONWEALTH OF PENNSYLVANIA
RAYMOND P. SHAFER, GOVERNOR

PENNSYLVANIA GAME COMMISSION
GLENN L. BOWERS, EXECUTIVE DIRECTOR

HARRISBURG PENNSYLVANIA

GENERAL PLAN
EMBANKMENT SECTIONS AND PLANS

PROJECT NO. 500 2-12 B (46-70)

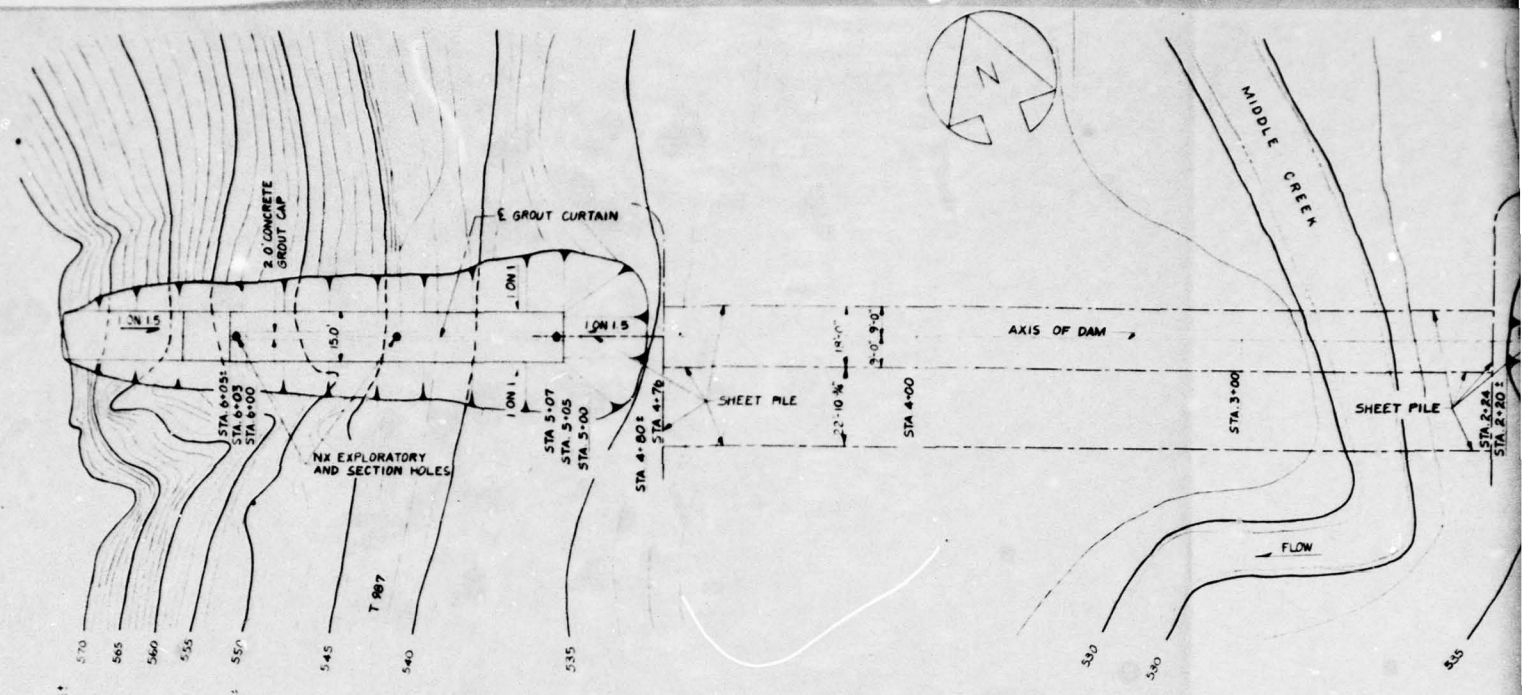
CONSTRUCTION OF MIDDLE CREEK DAM
MIDDLE CREEK WATERFOWL AREA
LANCASTER COUNTY, PENNSYLVANIA
FOR THE PENNSYLVANIA GAME COMMISSION

GARNETT FLEMING CORDRY & CARPENTER, INC.
ENGINEERS
HARRISBURG PENNSYLVANIA

SHEET NO. 5

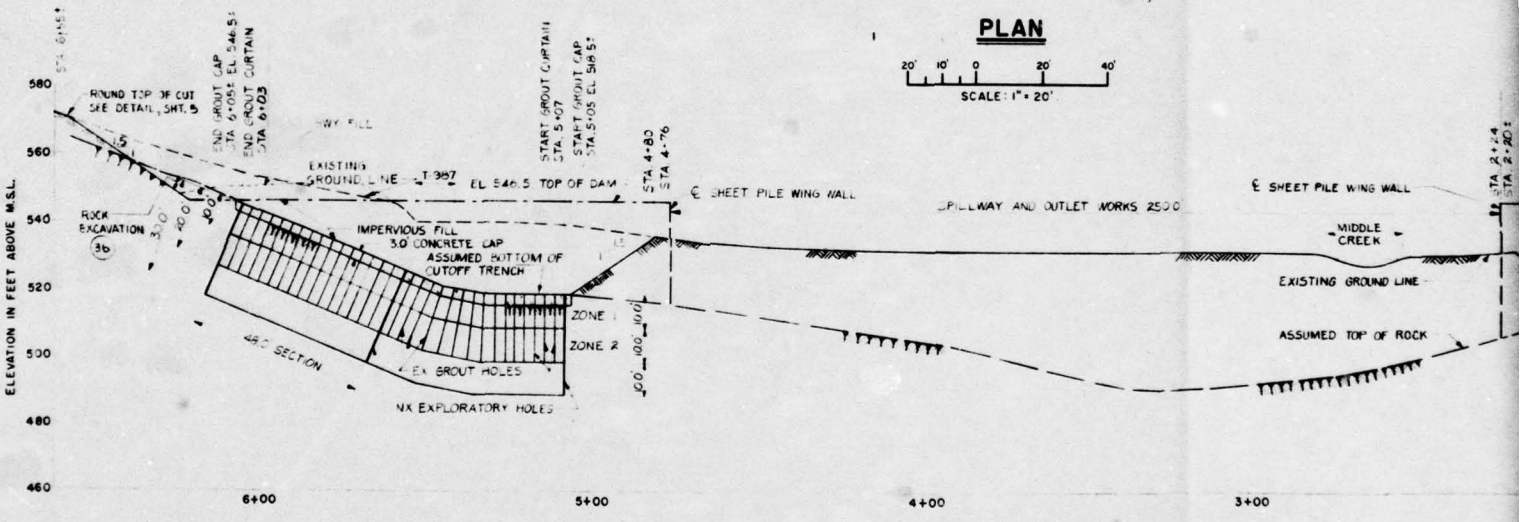
2

PA. 731
PLATE V



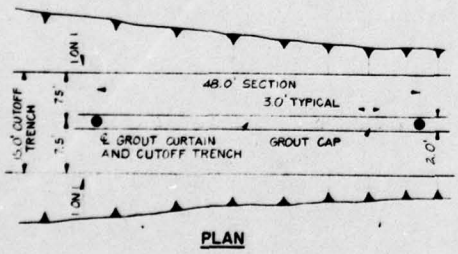
PLAN

SCALE: 1" = 20'



PROFILE ALONG ℄ GROUT CURTAIN

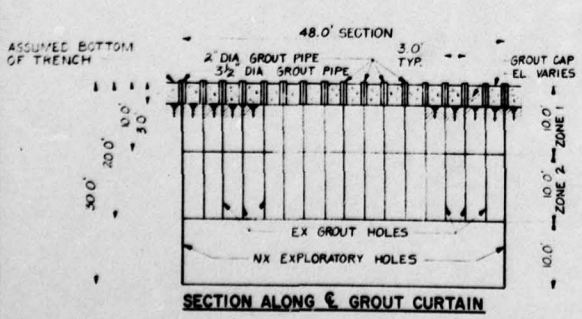
SCALE: 1" = 20'



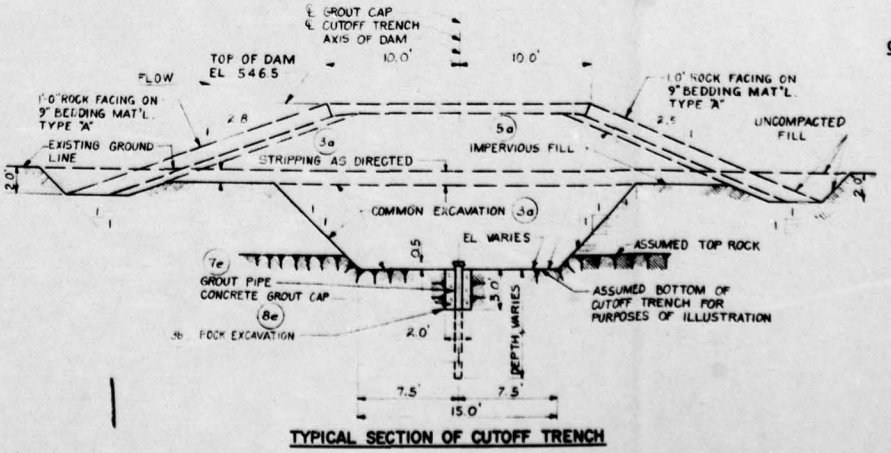
PLAN

LEGEND

- NX, 3" DIA EXPLORATORY HOLE
- EX, 1½" DIA PRIMARY HOLE
- EX, 1½" DIA SECONDARY HOLE
- EX, 1½" DIA TERTIARY HOLE



SECTION ALONG ℄ GROUT CURTAIN



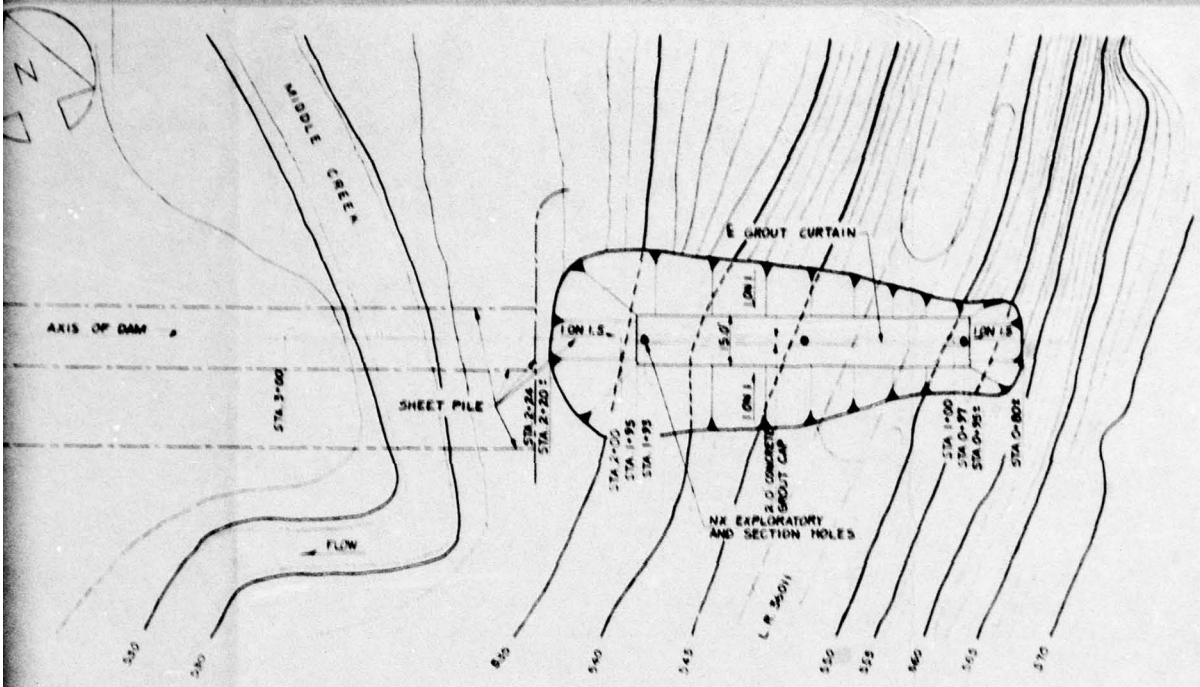
TYPICAL SECTION OF CUTOFF TRENCH

GROUTING DETAILING

NOT TO SCALE

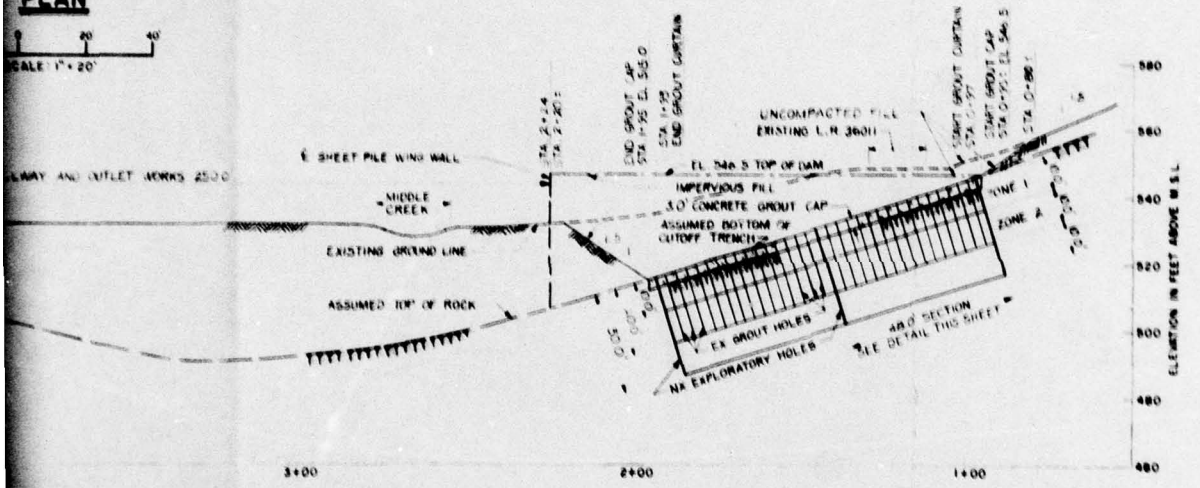
GENERAL N

1. USE 3½
HOLES
2. USE 2"
HOLES
3. IF AN EX
HOLE S
4. GROUT
BE ACC
PRIOR
5. GROUT
CAP AF
6. BACKFIL
PLACIN
7. CONCRE
MONOL
EACH
8. DRILLI
PAID F
9. DRILLI
PAID F
10. ALL G
ITEM
11. ALL GR
12. ROCK E
WILL
13. GROUT
ITEM
14. COPPER
ITEM
15. FOR C



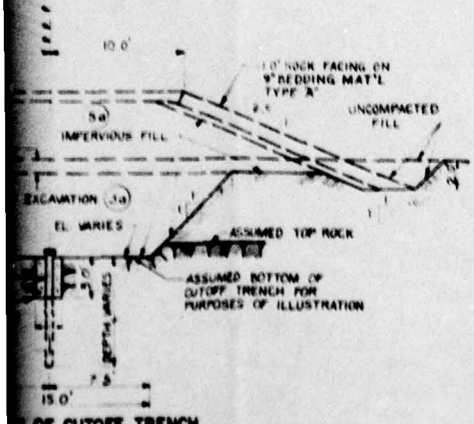
PLAN

SCALE 1" = 20'



ALONG ℄ GROUT CURTAIN

SCALE 1" = 20'



OF CUTOFF TRENCH

GENERAL NOTES

1. USE 3½" DIA BLACK STEEL PIPE FOR 3" (NX) GROUT HOLES.
2. USE 2" DIA BLACK STEEL PIPE FOR 1½" (EX) GROUT HOLES.
3. IF AN EXPANSION PLUG IS USED, THE TOP 18" OF THE HOLE SHALL BE DRILLED TO 3" DIA.
4. GROUT PIPES THROUGH CONCRETE GROUT CAP SHALL BE ACCURATELY PLACED AND FIRMLY SUPPORTED PRIOR TO PLACING CONCRETE.
5. GROUT PIPES SHALL BE CUT FLUSH WITH TOP OF GROUT CAP AFTER GROUTING IS COMPLETED.
6. BACKFILL ALL GROUT HOLES WITH GROUT BEFORE PLACING EMBANKMENT.
7. CONCRETE GROUT CAP SHALL BE PLACED IN 25' MONOLITHS WITH COPPER WATERSTOP BETWEEN EACH MONOLITH.
8. DRILLING NX, 3" DIA EXPLORATORY HOLES WILL BE PAID FOR UNDER ITEM (7b)
9. DRILLING EX, 1½" DIA EXPLORATORY HOLES WILL BE PAID FOR UNDER ITEM (7c)
10. ALL GROUT CONNECTIONS WILL BE PAID FOR UNDER ITEM (7d)
11. ALL GROUT PIPE WILL BE PAID FOR UNDER ITEM (7a)
12. ROCK EXCAVATION FOR THE CONCRETE GROUT CAP WILL BE PAID FOR UNDER ITEM (3b)
13. GROUT CAP CONCRETE WILL BE PAID FOR UNDER ITEM (8a)
14. COPPER WATERSTOP WILL BE PAID FOR UNDER ITEM (16)
15. FOR OTHER GENERAL NOTES SEE SHEET 5

REVISED

APPROVALS

COMMONWEALTH OF PENNSYLVANIA
RAYMOND P. SHAFER, GOVERNOR
PENNSYLVANIA GAME COMMISSION
GLENN L. ROGERS, EXECUTIVE DIRECTOR
HARRISBURG PENNSYLVANIA

EMBANKMENT
CUTOFF TRENCH AND GROUT CURTAIN

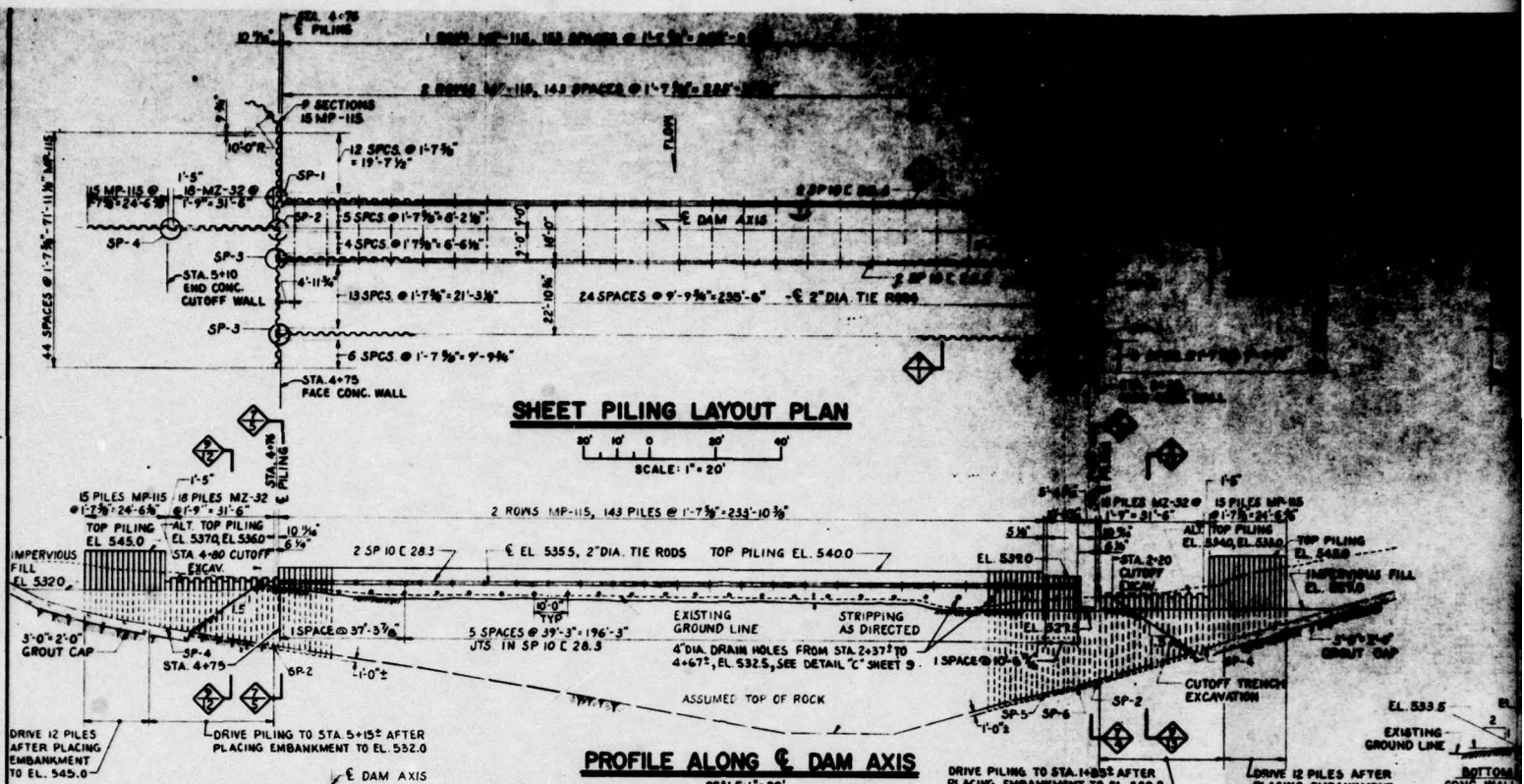
PROJECT NO. 800 2-12 (46-R)

CONSTRUCTION OF MIDDLE CREEK DAM
MIDDLE CREEK WATERSHED AREA
LANCASTER COUNTY, PENNSYLVANIA
FOR THE PENNSYLVANIA GAME COMMISSION

ENGINEERS

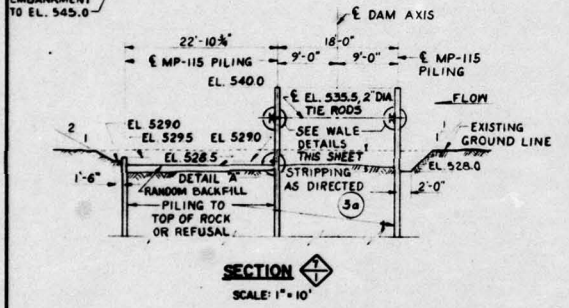
2

PA. 731
PLATE VI



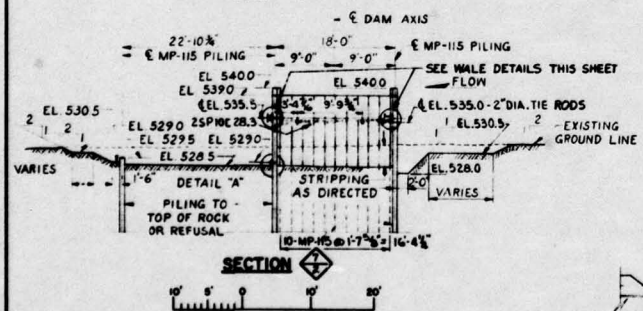
PROFILE ALONG ℄ DAM AXIS

SCALE: 1" = 20'



SECTION

SCALE: 1" = 10'



SECTION

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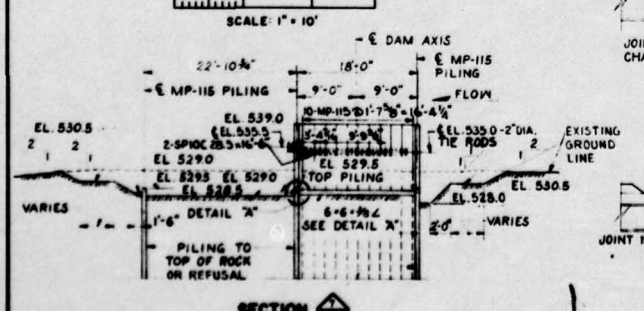
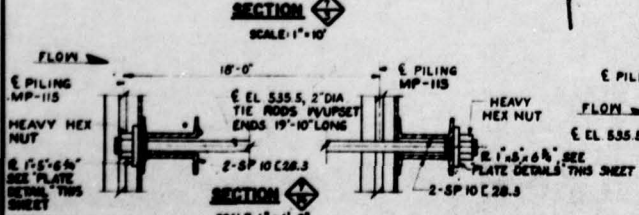
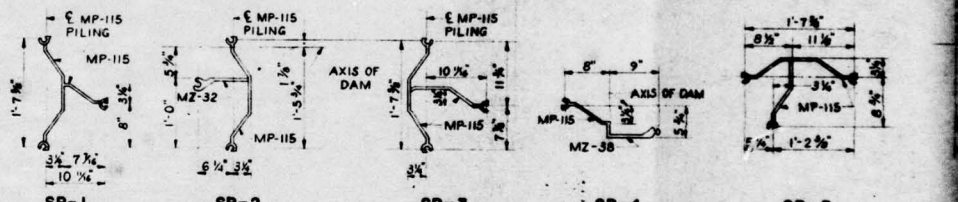
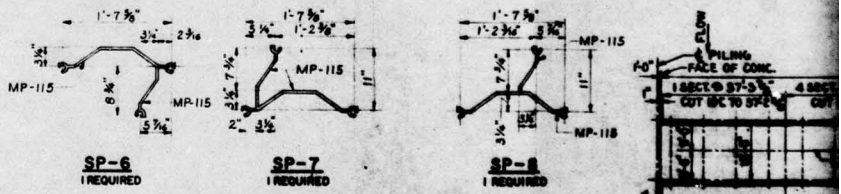


SECTION

SCALE: 1" = 10'

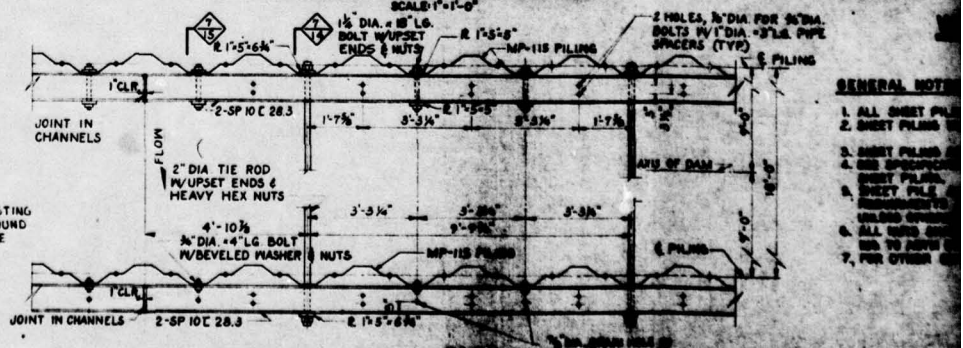




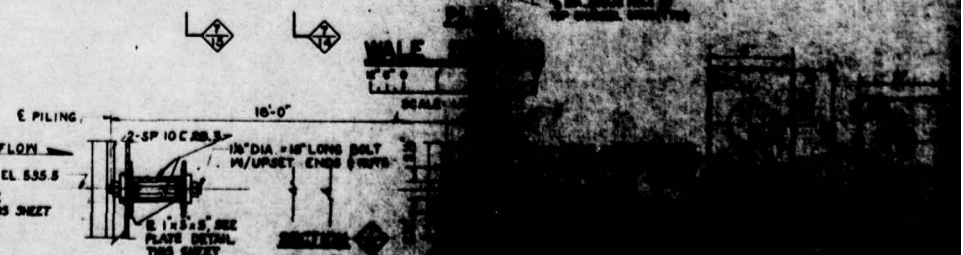


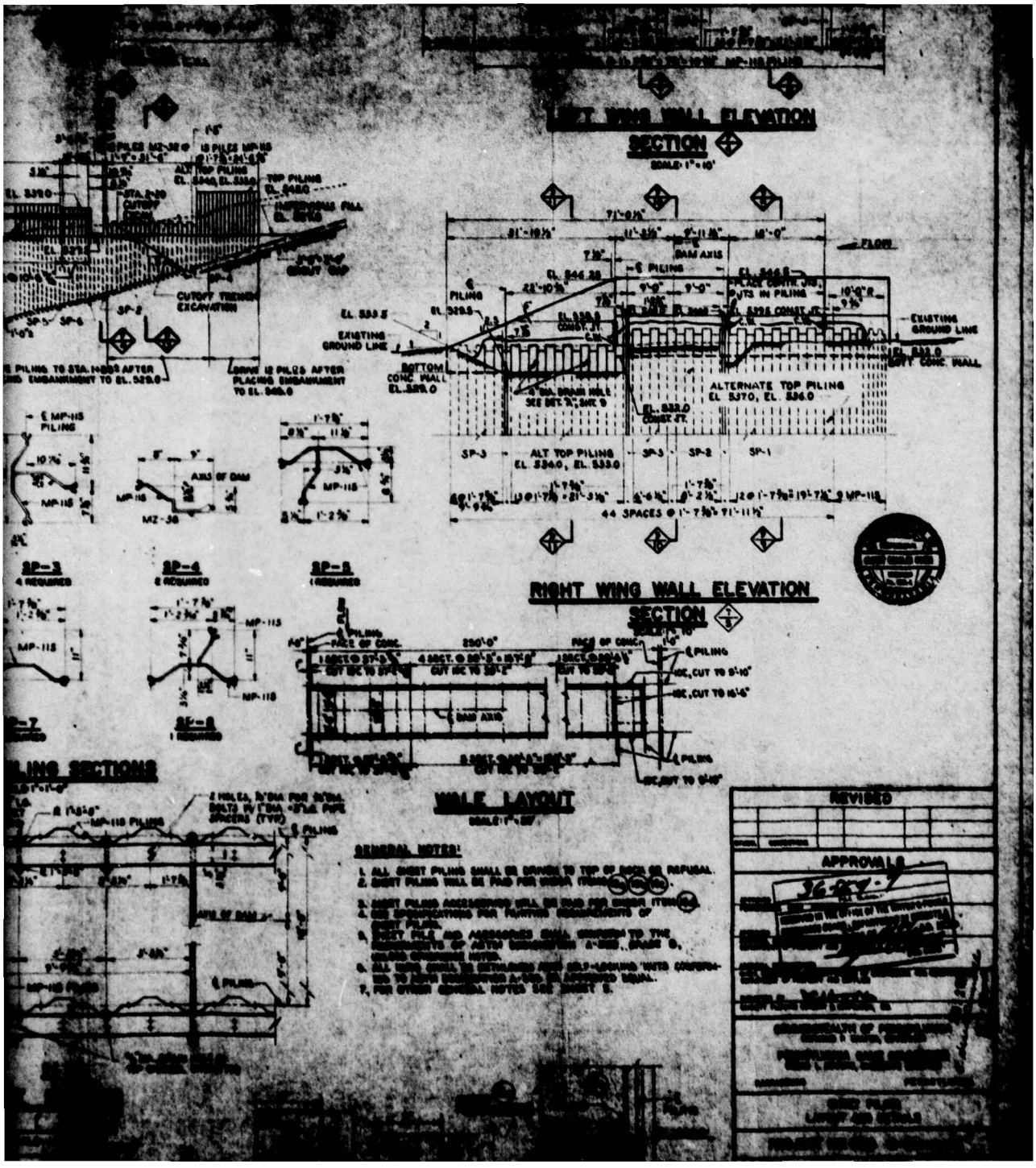
SPECIAL PILING SECTIONS

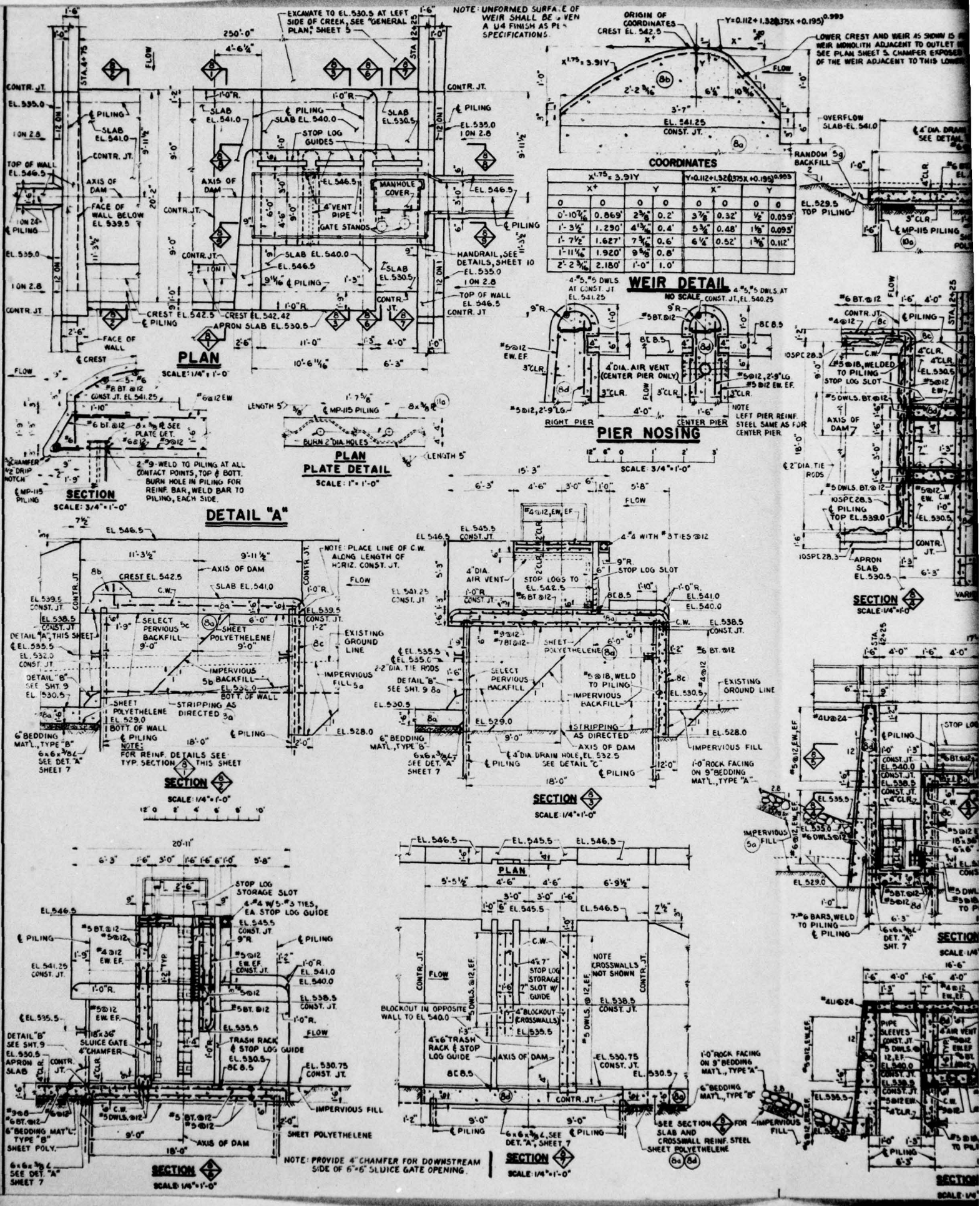
SCALE: 1" = 1'-0"

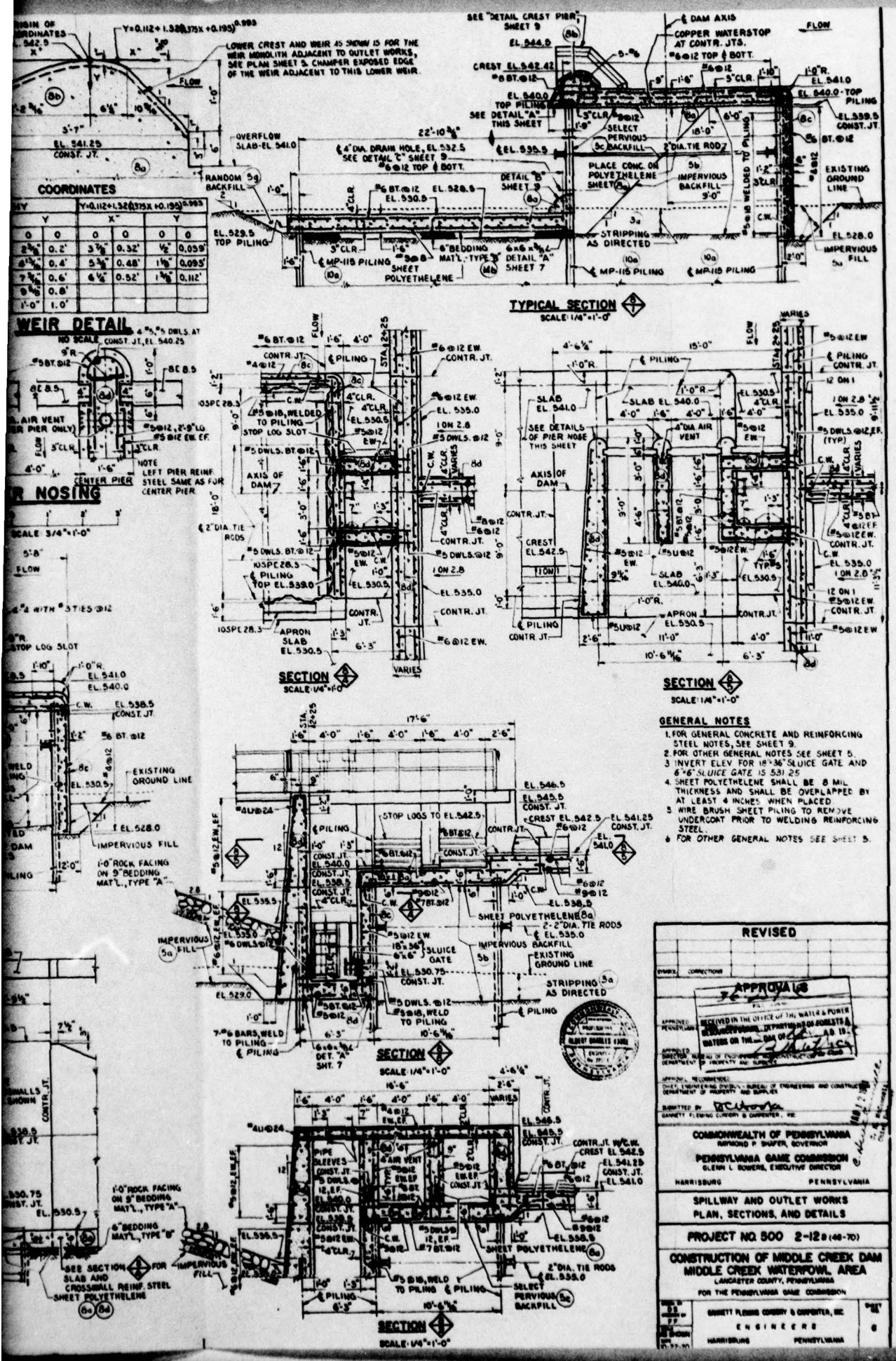


WALE




LEFT WING WALL ELEVATION
SECTION
SCALE: 1" = 10'
RIGHT WING WALL ELEVATION
SECTION
WALL LAYOUT
SCALE: 1" = 10'
GENERAL NOTES:
REVISED
APPROVED
ALTERNATE TOP PILING
EL 5370, EL. 536.0
44 SPACES @ 1'-7½" = 71'-11½"
EXISTING GROUND LINE
BOTTOM CONC WALL EL. 529.0
CUTOFF TRENCH EXCAVATION
SP-1
SP-2
SP-3
SP-4
SP-5
SP-6
SP-7
SP-8


PLAN
SCALE: 1/4" = 1'-0"
SECTION
SCALE: 3/4" = 1'-0"
PLAN
PLATE DETAIL
SCALE: 1" = 1'-0"
DETAIL "A"
SECTION
SCALE: 1/4" = 1'-0"
SECTION
SCALE: 1/4" = 1'-0"
PLAN
SECTION
SCALE: 1/4" = 1'-0"
SECTION
SCALE: 1/4" = 1'-0"
WEIR DETAIL
NO SCALE
PIER NOSING
SCALE: 3/4" = 1'-0"
SECTION
SCALE: 1/4" = 1'-0"
SECTION
SCALE: 1/4" = 1'-0"
COORDINATES
NOTE: PROVIDE 4" CHAMFER FOR DOWNSTREAM SIDE OF 6'-6" SLUICE GATE OPENING.



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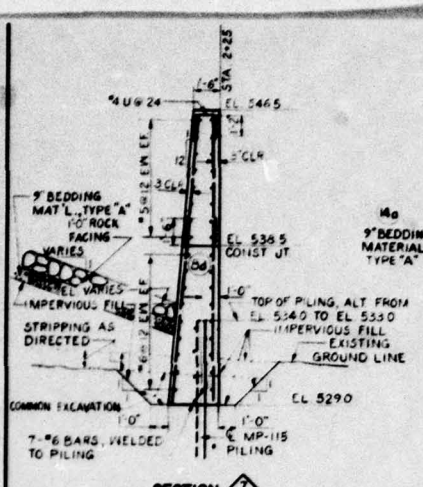
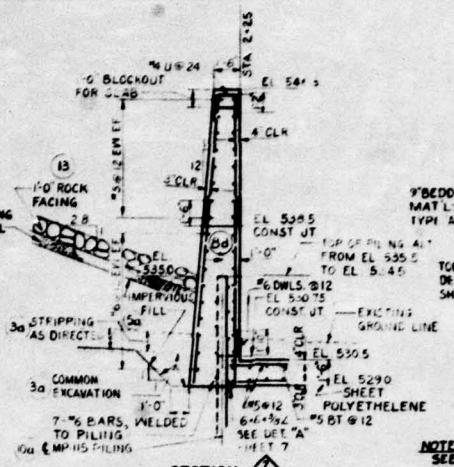
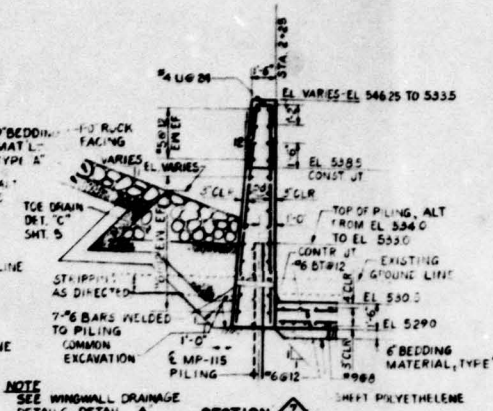
PA. 731
PLATE VIII



SECTION 4/7
SCALE 1/4"=1'-0"

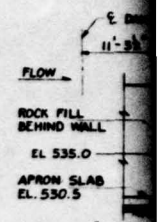


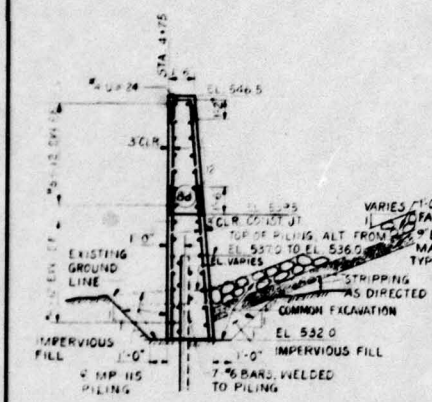
SECTION 4/7
SCALE 1/4"=1'-0"



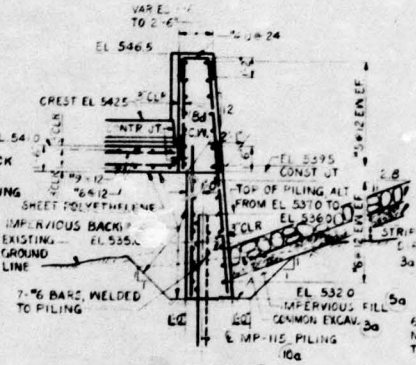
NOTE
SEE WINGWALL DRAINAGE DETAILS, DETAIL "A" THIS SHEET

SECTION 4/7
SCALE 1/4"=1'-0"

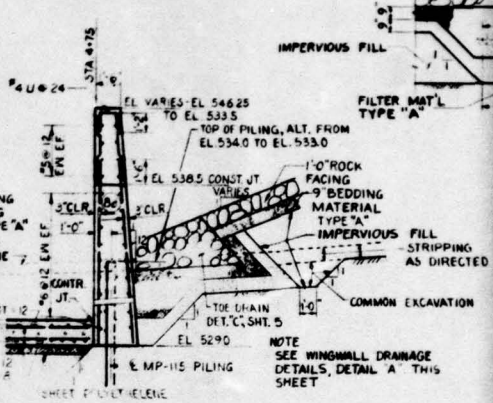




SECTION 4/7
SCALE 1/4"=1'-0"

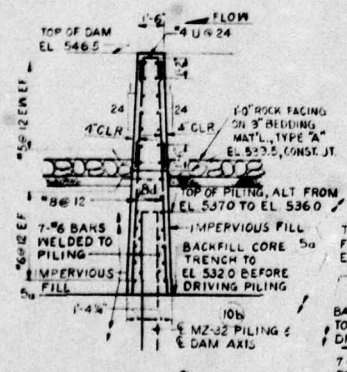


SECTION 7/10
SCALE: 1/4"=1'-0"

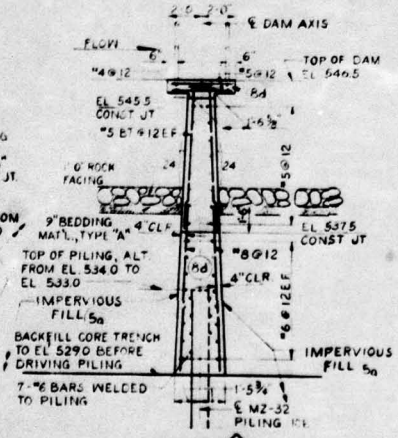


NOTE
SEE WINGWALL DRAINAGE DETAILS, DETAIL "A" THIS SHEET

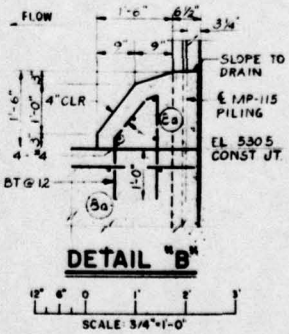
SECTION 4/7
SCALE: 1/4"=1'-0"



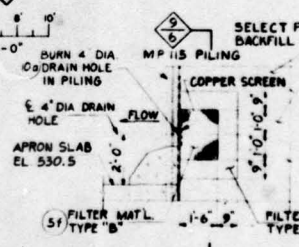
SECTION 4/7
SCALE: 1/4"=1'-0"



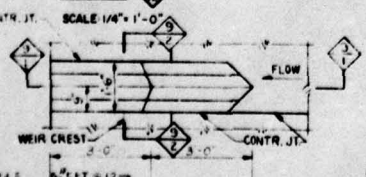
SECTION 4/7
SCALE: 1/4"=1'-0"

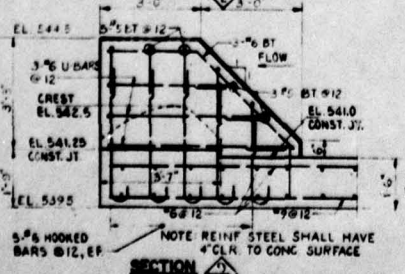


DETAIL "B"
SCALE: 3/4"=1'-0"

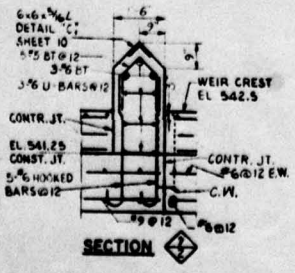


SECTION THRU DRAIN HOLE



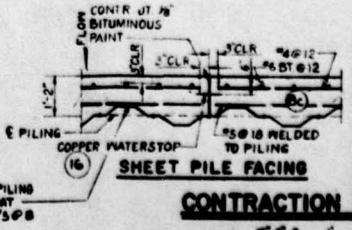


SECTION 4/7



SECTION 4/7

DETAIL CREST PIER
SCALE: 1/2"=1'-0"



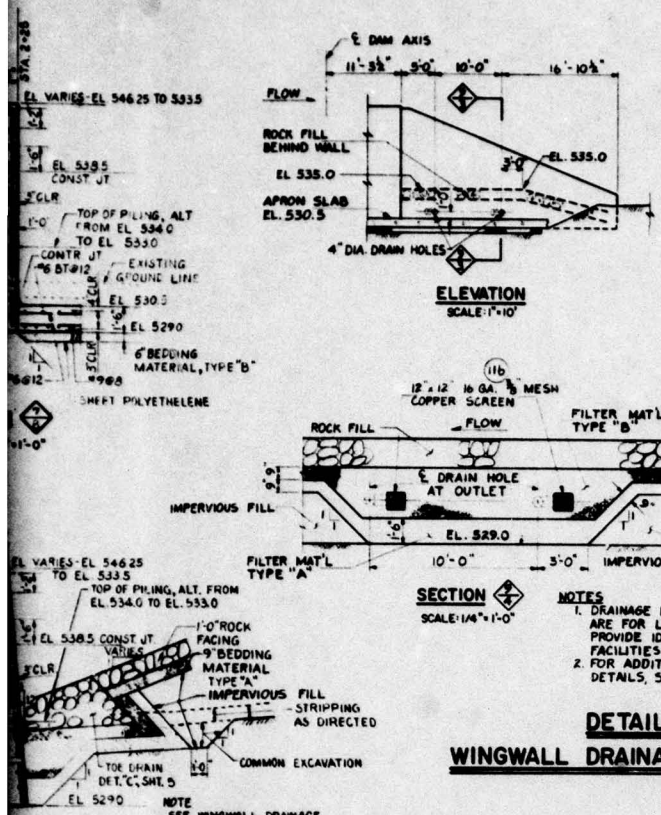
SHEET PILE FACING

9 WIRE BRUSH SHEET PILING TO REMOVE UNDERCOAT PRIOR TO WELDING #5@8

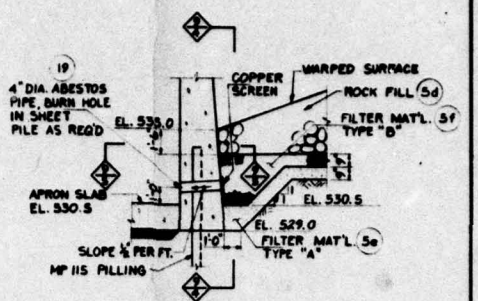
SHEET PILE D

CONTRACTION JO

SCALE: 1/8"=

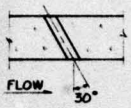


ELEVATION
SCALE: 1"=10'



SECTION
SCALE: 1/4"=1'-0"

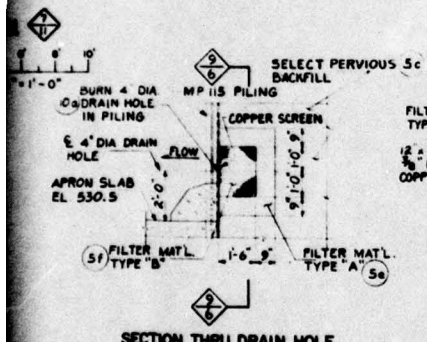
SECTION
SCALE: 1/4"=1'-0"



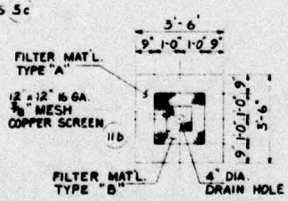
SECTION
NO SCALE

NOTES
1. DRAINAGE DETAILS AS SHOWN ARE FOR LEFT WINGWALL. PROVIDE IDENTICAL DRAINAGE FACILITIES FOR RIGHT WINGWALL
2. FOR ADDITIONAL DRAINAGE DETAILS, SEE DETAIL "C", SHEET 5.

DETAIL "A"
WINGWALL DRAINAGE DETAILS



(9/6) SECTION THRU DRAIN HOLE



NOTE
FOR DRAIN HOLE LOCATION SEE PROFILE SHEET 7.

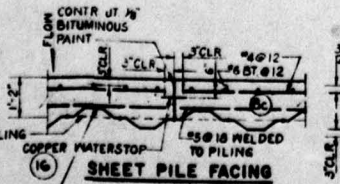
(9/6) SECTION

GENERAL CONCRETE AND REINF. STEEL NOTES

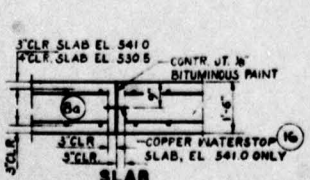
1. ALL EXPOSED EDGES OF CONCRETE SHALL BE CHAMFERED 1½" UNLESS OTHERWISE SHOWN OR DIRECTED.
2. ALL REINFORCING STEEL SPLICE LAPS AND EMBEDMENTS SHALL BE IN ACCORDANCE WITH THE A.C.I. STANDARD BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE (A.C.I. 318-63).
3. ALL BAR BENDING DETAILS SHALL BE IN ACCORDANCE WITH A.C.I. STANDARDS UNLESS OTHERWISE SHOWN.
4. ALL REINFORCING STEEL SHALL BE PLACED WITHIN 3" OF CONTRACTION JOINTS.
5. ALL CONTRACTION JOINTS SHALL BE PAINTED WITH ⅛" THICK BITUMINOUS PAINT.
6. ALL REINFORCING STEEL WILL BE PAID FOR UNDER ITEM (9)

DETAIL "C"
SHEET PILE DRAINAGE DETAILS
SCALE: 3/8"=1'-0"

GENERAL NOTES
1. FOR GENERAL NOTES SEE SHEET 5.



SHEET PILE FACING



SLAB
CONTRACTION JOINT DETAIL
SCALE: 1/2"=1'-0"

REVISED

SYMBOL	CORRECTIONS

APPROVALS

APPROVED [illegible]

APPROVED [illegible]

APPROVED [illegible]

SUBMITTED BY
BARRETT FLEMING CORDRY & CARPENTER, INC.

COMMONWEALTH OF PENNSYLVANIA
RAYMOND P. SHAFER, GOVERNOR
PENNSYLVANIA GAME COMMISSION
GLENN L. BOWERS, EXECUTIVE DIRECTOR
HARRISBURG PENNSYLVANIA

SPILLWAY AND OUTLET WORKS
WINGWALL SECTIONS AND MISCELLANEOUS DETAILS

PROJECT NO. 500 2-12 B (46-70)

CONSTRUCTION OF MIDDLE CREEK DAM
MIDDLE CREEK WATERFOWL AREA
LANCASTER COUNTY, PENNSYLVANIA
FOR THE PENNSYLVANIA GAME COMMISSION

BARRETT FLEMING CORDRY & CARPENTER, INC.
ENGINEERS

SHEET 9

2

PA. 731
PLATE IX